THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXIX. No. 737.] LONDON, JUNE 26, 1877. [29TH YEAR.] Price 6d.

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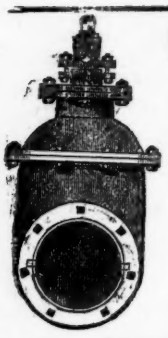

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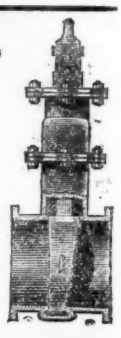

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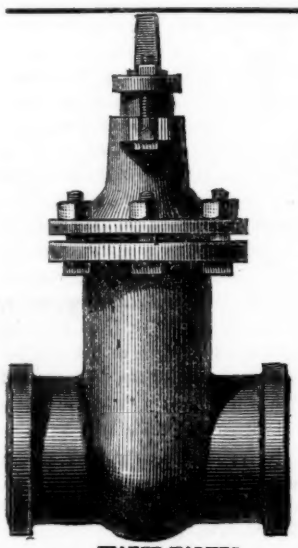

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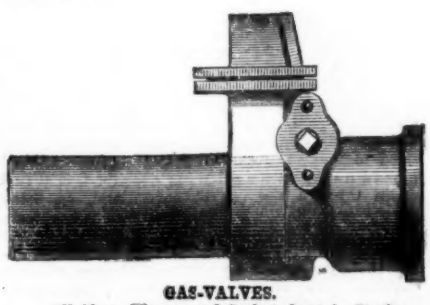

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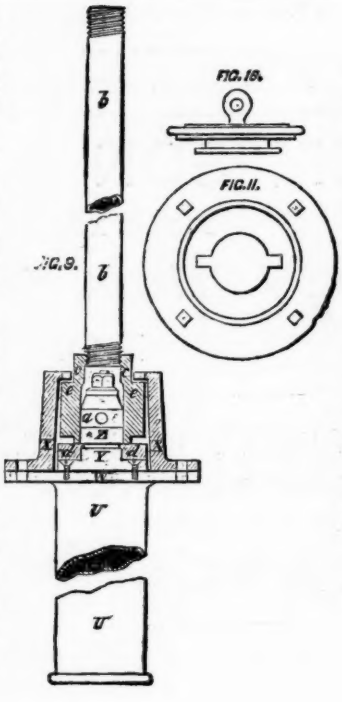

Fig. 9 represents the arrangement for the attachment of removable market or other gas stand-pipes. The view is a side elevation and part section. To the top of the service, U, is fixed a plate, W, and upon that is fastened by bolts the case or box, X. To the plate, W, is also fixed, by screws, the plug or valve, Y, and upon this plug the barrel Z is free to turn. That part of the barrel marked *a* is square. The stand-pipe, *b*, has attached to its lower end the collar, *c*, which is square in the interior, so as to slip over and turn the barrel by the square part, *a*, until the hole in the plug and that in the barrel coincide, when a gas-way will be established between the service, U, and the stand-pipe, *b*. A gas-tight joint between the collar, *c*, and the plate of the plug or valve, Y, is made by the former being forced down upon an india-rubber washer, *d*, by the upper part of the feathers, *e*, of the collar, *c*, coming in contact with inclined projections cast on the inner side of the box, X.

Fig. 10 is a plan of the top of the box or case containing the valve.

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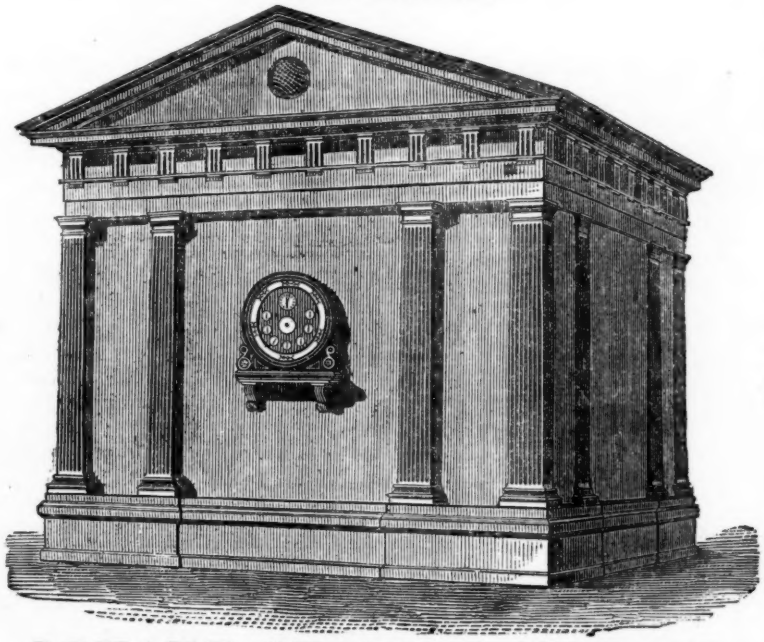

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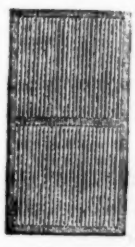

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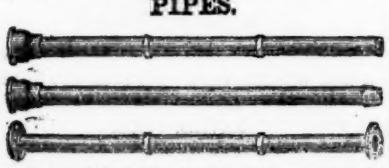
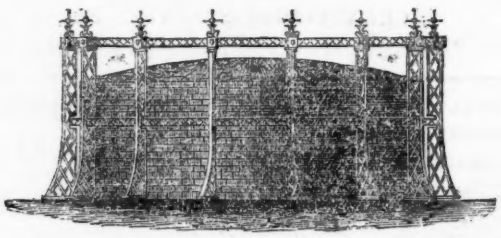
BIRKENHEAD.

GAS AND WATER PIPES.
WILLIAM MACLEOD & CO.,
23 & 25, OSWALD STREET, GLASGOW.
CAST-IRON GAS AND WATER PIPES.



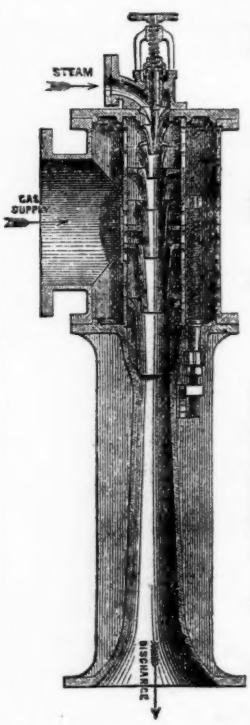
DELIVERY F.O.B., GLASGOW.
Prices on application.

ALFRED WILLIAMS,
PHŒNIX FIRE-BRICK WHARF,
64, BANKSIDE, SOUTHWARK, LONDON, S.E.
ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS,
AND FOR THE
SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,
AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.



THE HORSELEY COMPANY,
LIMITED,
TIPTON, STAFFORDSHIRE.
LONDON OFFICE:
6, WESTMINSTER CHAMBERS, VICTORIA STREET,
GAS ENGINEERS, IRONFOUNDERS, &c.,
MANUFACTURERS OF
GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED, LAMP-POSTS, PIPES,
AND ALL REQUISITES FOR EITHER
GAS OR WATER WORKS;
ALSO
MAKERS OF ROOFS, BRIDGES, &c.

KÖRTING BROS.,
Steam-Jet Engineers,
7 and 17, LANCASTER AVENUE,
MANCHESTER,
AND 40, LOWER GARDINER STREET, DUBLIN.



E. KÖRTING'S PATENT
STEAM-JET GAS-EXHAUSTER.
IMPROVED CLELAND'S PATENT.
Small Cost—Compactness—Perfectly Self-Acting—Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—No Extra Room Required—No Wear and Tear—No Noise—No Oscillation in Vacuum, or Back Pressure.
UPWARDS OF 200 IN USE.
SUPPLIED TO—

Chartered Gas Co.	Glasgow Corporation.	Hanna, Donald, and Wilson, London.
London Gas Co.	Leyland Gas Co.	Ratcliff Gas-Works.
S. Metropolitan Gas Co.	Stalybridge Gas-Works.	Kendal Gas-Works.
Phœnix Gas Co.	Lincoln Gas-Works.	Longton Gas Co.
Liverpool Gas Co.	Birmingham Gas-Works.	Dartford Gas Co.
Bolton Corporation.	Wakefield Gas-Works.	Exeter Gas Co.
Horsham Gas Co.	Brentford Gas-Works.	Harrogate Gas Co.
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Ipswich Gas Co.	Guildford Gas-Works.	Waterside Gas-Works, Todmorden.
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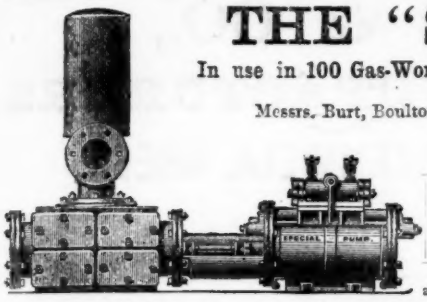
Sandwich Gas Co.	Kirkintilloch Gas-Wks.	
Cornholme Dis. Gas-Wks.	Nantwich Gas-Works.	
Bury Gas-Works.	Enniskillen Gas-Works.	
	&c., &c., &c.	

E. KÖRTING'S PATENT STEAM-JET REVIVIFYING BLOWERS FOR THE PURIFYING MATERIAL.
SOLE LICENSEES FOR
W. CLELAND'S PATENT STEAM SCRUBBER AND SLOW-SPEED CONDENSER.
FOR PARTICULARS, APPLY TO
KÖRTING BROS., 7 and 17, Lancaster Avenue,
MANCHESTER,
and 40, Lower Gardiner Street, Dublin,
OR TO
GERALD J. TUPP, 8, John Street, Adelphi, W.C.,
LONDON,
SOLE AGENT FOR ENGLAND AND WALES.



THE "SPECIAL" STEAM-PUMP.

In use in 100 Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

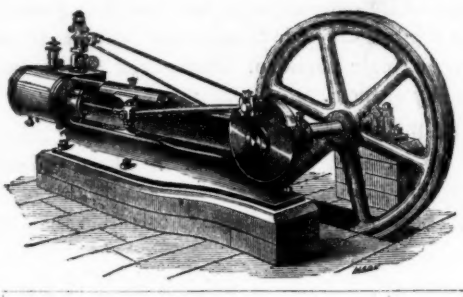
Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

200 Sizes made. The following are the Leading Sizes for Gas-Works:—

Steam Cylinder . . . in.	3	4	3	5*	5*	4	6*	5	7*	6	8*	7	10*
Water Cylinder . . . in.	1½	2	3	2½	3	4	4	5	5	6	6	7	7
Gallons per hour . . .	450	815	1830	1250	1830	3250	3250	5070	5070	7330	7330	9750	9750
Price	£16	£18	£18	£21	£22½	£25	£30	£32½	£40	£40	£50	£50	£65

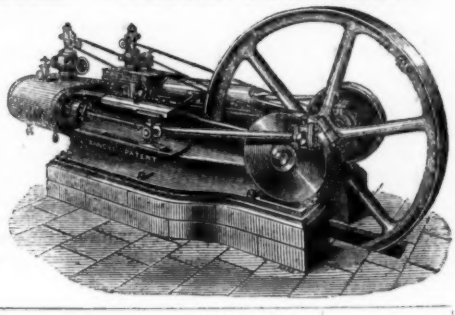
* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HORIZONTAL HIGH-PRESSURE STEAM-ENGINES.

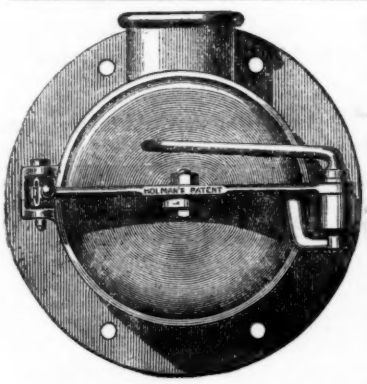


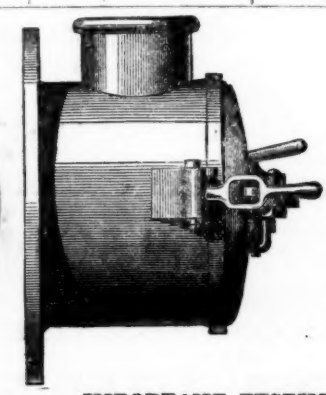
THE DESIGN,
WORKMANSHIP,
AND
LOW PRICE
OF THESE ENGINES
HAVE CALLED FORTH
UNIVERSAL APPROVAL.

Over 2000 Sold
Since December, 1869.



SIZE	B	C	D	E	G	H	I	J	K	M
Nominal Horse Power	TWO	THREE	FOUR	SIX	EIGHT	TEN	TWELVE	FOURTEEN	EIGHTEEN	TWENTY-FIVE
Price of Engine, with Governor	£28 0	£38 0	£46 0	£70 0	£90 0	£115 0	£127 0	£140 0	£195 0	£220 0
Feed-Pump, extra.	3 0	3 15	4 0	5 10	6 0	7 10	7 10	8 0	10 0	15 0
Variable Expansion Gear, extra	..	..	..	..	13 0	14 0	15 0	15 0	20 0	25 0





MORTON'S
Patent Self-Sealing
RETORT LIDS,

WITH

HOLMAN'S NEW PATENT BRACKETED CROSS-BARS, ANTI-FRICTION CATCHES, AND ECCENTRIC FASTENINGS.

Instantaneous Sealing effected. No Luting. No Duplicate Lids required. Holman's New Self-Sustaining Cross-Bar ensures freedom of joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested (rigid cast iron is now successfully employed), nearly 25,000 being in use at various Gas-Works in London and the Provinces.

IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (commonly called the Chartered Gas Company), Beckton, North Woolwich.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them. I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly, (Signed) G. C. TREWBY.

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

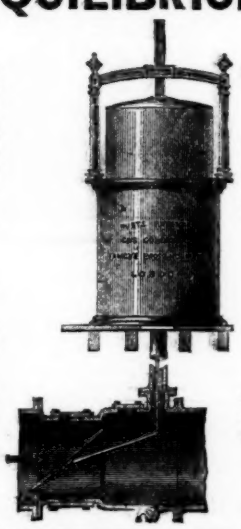
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at any convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dronfield, Dursley, Exeter, Guernsey, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION TO

TANGYE BROTHERS & HOLMAN,

SOLE MANUFACTURERS,

LAURENCE POUNTNEY LANE, LONDON, E.C.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

TO GAS ENGINEERS AND MANAGERS.

It having come to our knowledge that a report is in circulation, spread by some unprincipled person or persons, that the cases of our larger-sized Meters are made of Galvanized Iron, we think it only fair to ourselves, and just to our customers, to say, that we never have used, in making any of our Meters, a single pound of *Galvanized Iron*, or any other *cheap* and *inferior material*, and this can be easily seen by opening any of them.

The cases of our large-sized Meters, from 20 lights and upwards, are all made of the very *Best Best Patent Alloy*, which is nearly double the price, and will last more than double the time, of some other material that has been and still is very largely used for the same purpose. And our experience, acquired by an extensive use of it for upwards of 30 years, enables us to say with confidence that no other metal in use for the purpose is so little liable to corrosion from the action of the gas.

We have now in use a Meter made in 1848, and therefore 29 years old, the case of which is made of Patent Alloy; the Meter is still in perfect order, and shows no signs of decay.

The utmost care is exercised by us in selecting none but the very best materials for all parts of our Meters; much of it is made *expressly for us*, as it is not possible to obtain it in the open market of the same superior quality.

The great fall in the price of all materials used in making our Meters has enabled us to give an increased discount, thus giving our customers the benefit of the fall. This we were bound in fairness to do, as we raised the price of our Meters four years ago, when the price of all metals went up.

It will be our constant endeavour, by using none but the best materials, and employing the most skilful workmen, to maintain the high character our Meter has hitherto borne.

WILLIAM PARKINSON & CO.

(ESTABLISHED 1816)

ARE THE ONLY MAKERS

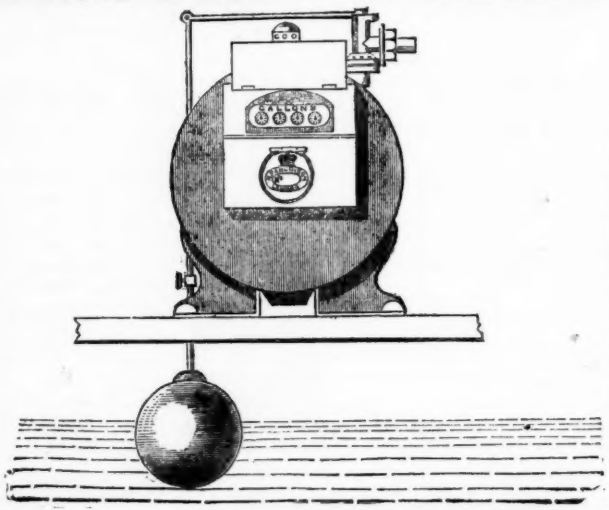
OF THE

LOW-PRESSURE WATER-METER.

These Meters will register with perfect accuracy, either at full speed, or with a few drops only passing through them.

They must be placed over the cistern to be supplied, and the water, after being measured, will fall from the outlet into the cistern below. Each Meter is fitted with a ball-valve, so made that it can be adjusted to shut off the supply at the inlet when the water reaches any required height in the cistern.

The 100-gallon Meter is fitted with a cistern holding about three or four gallons, and may be fixed inside a house, free from the effects of frost, and requires no attention after once being fixed.



From "The Engineer," April 6, 1877.

"Low-pressure Meters have been found to register with almost perfect accuracy, or, at all events, within 5 per cent. either for or against the consumer, and from the nature of their construction are by no means easily deranged. Still, even the low-pressure meters have their disadvantages, but these are chiefly as respects the question of first cost, seeing that they must have a cistern fixed at a higher level than that at which the supply is needed. All things considered, however, the balance of opinion rules at present in favour of the low-pressure Meter, and they are consequently increasing in favour as time goes on."

These Meters have been manufactured by W. P. & Co. for more than 25 years, and are largely used by the following and other Water Companies:—

NOTTINGHAM, DERBY, LEICESTER, SUNDERLAND, GREAT YARMOUTH, SHEFFIELD, NORWICH, LOWESTOFT, COVENTRY, SOUTHEND.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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Post Orders to be made payable at the Chief District Office, St. Martin's-le-Grand, London, to William B. King.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 26, 1877.

Circular to Gas Companies.

ONE of the penalties a man pays for having achieved a great reputation, is the liability to be bored by correspondents; and, perhaps, no statesman or author, living or dead, has ever suffered more from this source than Mr. Gladstone. Gushing young ladies want an autograph to paste in an album; sucking politicians want opinions on crude theories; and older ones want hobbies backed up; and so the torment incessantly goes on.

It is not to be wondered at, that when one correspondent has asked and obtained Mr. Gladstone's opinion as to whether or not it is desirable for Local Authorities to become possessed of commercial undertakings such as gas-works, another should interrogate him as to the principle on which such undertakings should be conducted, supposing they belonged to a representative body. The reply to Mr. Silverthorne, which we published in our last issue, was somewhat enigmatical, and the same may be said of the answer we print to-day. No one, however, can be surprised at this, for a great statesman cannot be expected to bind himself by expressing a decided opinion, on a rather intricate question, to any casual correspondent who may address him.

Our own opinions are, of course, well known to our readers. We regard the supply of gas and water as legitimate commercial enterprises, which it is beyond the province of Local Authorities to enter upon—at all events, with a view to profit to be applied to purposes other than those appertaining to the undertakings. We consider all the *net* profits of gas undertakings in the hands of Local Authorities as so much additional taxation of the gas consumers; and we feel confident that if Mr. Gladstone had leisure to give a little attention to the subject, he would agree with us. As it is, he admits that the axiom of the late Mr. J. S. Mill, quoted by our correspondent, is undoubtedly sound. A rate levied by a Local Authority for a particular service should be calculated so as to produce as nearly as possible the exact sum required to defray the expenses of rendering such service. It is clear, then, that the opinion of the great political economist is, that the only legitimate principle on which a corporate gas undertaking can be managed is the Scottish plan, the adoption of which we advocate.

Mr. Gladstone may be perfectly right, from his own point of view, in stating that particular cases might require separate consideration; but we must confess that we can imagine no case in which this law ought not to be followed. It would, in our opinion, to mention a supposititious case which affords the closest analogy, be just as legitimate for an authority to levy a threepenny lighting rate when only a penny was necessary, and devote the excess to general purposes, as to charge gas consumers more for gas than was necessary to defray all the expenses of production and distribution. No local authority would, of course, dream of inflicting the treble taxation here supposed, and yet it is the desire of many to acquire gas undertakings, in order that they may make a quite analogous infliction. In this Metropolis we feel certain that the intelligence of the population would effectually prevent any such misuse of the gas undertakings. But we need not speculate. The day is very distant when the metropolitan undertakings will pass into the hands of any corporate authority. It may be further delayed, or its arrival may be altogether prevented by the adoption of the system of economic management advocated by Mr. Gladstone, which can easily be effected by the general amalgamation of the Metropolitan Gas Companies.

We have at the present moment—unfortunately for us—no gas dispute agitating the Metropolis. The vexed "sulphur" question has, we understand, been relegated to what we must call the legal tribunal—the Referees—who, with the evidence taken at the late inquiry before them, will, no doubt, consent to a relaxation of their recent orders, at all events in the winter months. It seems clear that the Metropolitan Board of Works, who rule over by far the larger part of the metropolitan area, would be perfectly satisfied if a maximum of thirty-five or forty grains of sulphur per 100 cubic feet were allowed. With this the Companies might be able to comply, by making use of modes of purification which would not involve the production of a nuisance; and we regard the limit suggested by Mr. Keates, and evidently approved of by the Metropolitan Board, as fair to the Gas Companies, and not prejudicial to the consumers.

We print, to-day, two of the communications made at the meeting of the British Association of Gas Managers, and all our readers will agree that they possess great practical value. The account given by Mr. Paterson of his experience with the Körting-Cleland Steam-Jet Exhauster thoroughly supports the opinion we have more than once expressed as to the adaptability and economy of this instrument. The chief point raised in the discussion was the situation in which the exhauster should be placed. Mr. Paterson, and we believe Mr. Cleland at his own works, has put it at the outlet of the scrubber; but it was urged by some members that a better situation was at the end of the main leading from the hydraulic. The President correctly remarked that when put in the former position it involved doing the same work twice over. We shall not stop to discuss details which all our readers will peruse, but we may allude to one point which appears to us of much interest. It has always been claimed in Germany, where this exhauster is more employed than in this country, that its use improves the illuminating power of the gas. The reason for this we confess we did not see, until it was explained the other day by Mr. Paterson. He has found that the heat of the steam in contact with half-condensed gas effects a partial distillation of the tar—does, in fact, exactly what the process of Messrs. Aitken and Young is intended to accomplish. The more volatile constituents of the tar are converted into vapours which dissolve in the gas, and serve to enrich it. This, as we have said, is a point of much interest, and we hope it will receive further attention.

The paper read by Mr. Brett, "On the Supply of Gas to "Public Lamps," was eminently practical, and his treatment of the subject was exhaustive. Few things have occasioned more worry to Gas Managers than the incessant disputes of their companies with the Local Authorities as to the public lights. We fully agree with the author in his opinion that where a company supply the gas, all the plant should belong to, and be under the control of, the company. The Local Authority may have their inspectors if they please, but they should not be allowed to touch or disturb anything except in the presence of an officer of the Company. With the practical suggestions which follow, as to the plans to be adopted for the preservation of service-pipes, their size, and that of the stand-pipe, we fully agree, and also as to the choice of burners and the careful fixing of them. We may pass to Mr. Brett's remarks on the meter system. To us, who have for many years advocated the general adoption of that system, it is extremely gratifying to find that managers in general are becoming convinced of its advantages. We do not regard the average system as doing complete and perfect justice to Gas Companies. There are, of course, but two plans which would effect this—the separate main advocated by Mr. Wilson, which would be impossible over a large area; or a meter to every lamp, which would lead to inconveniences. The best course is the average meter system, which, when approved of by a man of so much experience in connexion with public lighting in the Metropolis, as Mr. Johnson, must commend itself to all. We do not despair of seeing Mr. George Anderson on the stool of repentance before long. Passing by, for want of a special knowledge of the facts, the disastrous results at Watchet, we may once more contend that the system offers the easiest means of establishing peace and contentment between the supplying Company and the Authority supplied. This, by itself, is no mean gain; but we were pleased to hear a generally-expressed belief that no loss resulted to the Company. All that is required for their protection is vigilant supervision. The question as to whether public lamps should be supplied at a lower rate than that charged to private consumers was ably dealt with by the President, who pointed out that cheap public lighting meant dearer gas to private consumers, and, in the long run, must be detrimental to their interest.

An exhibition of M. Jablochkoff's "Electric candle" was successfully made, last Friday week, at the West India Docks, at which we were not present, but we have no hesitation in congratulating the inventor on the results, for it demonstrated more clearly than ever that gas has nothing to fear from competition with the "candle." That the electric light will enable people to distinguish shades of colour accurately, we all know; but these are early closing days, and evening shopping gets less and less. That it might be possible to light the deck of a ship, and even the hold, was certain; but then ships do not use gas, and, in order to be lighted with an electric candle, they must carry a steam-engine and a magneto-electric machine. We notice that none of the experiments detailed lasted longer than about twenty minutes, and we understand that the "kaolin" points require to be changed about every half hour, involving the extinction of all the "candles" actuated by the same machine. The change, we are told, is very expeditiously made, but a total eclipse of the light for only a minute or two would produce grave inconvenience under many circumstances. As yet, we have no more complete information as to the cost of the light than we gave from our French contemporary last week.

Nothing daunted by a crushing defeat in the House of Commons, the Hanley Town Council have again endeavoured to open negotiations with the British Gas Company for the Potteries Works. The reply is as before—the Company absolutely refuse to sell; there the matter rests, and will rest, we believe, for a long time.

Water and Sanitary Notes.

The Public Health (Metropolis) Bill, surreptitiously, we may say, introduced into the House of Commons, and carried to a second reading before it was printed, has, as we expected would be the case, occasioned a good deal of excitement among the Vestries and District Boards in the Metropolis. It is not that they object to the measure, so far as it is simply a consolidating Bill; but they, very naturally, take alarm at the large powers it would confer on the Local Government Board. For these powers, we, with a wide knowledge of the operation of the sanitary laws, as administered by the Metropolitan Local Authorities, feel bound to say there is no necessity. Although we are not prepared to deny occasional defaults on the part of Vestries, to take proceedings when well-founded complaints are made, we cannot see that the interference of the Local Government Board is at all required in such cases. A much simpler mode of proceeding would suffice. There is one thing that may be urged in favour of the Bill. All the provisions it contains, or very nearly all—for we have not time to go through the several Acts which are here consolidated—are already in force all over the country, except within the limits of the Metropolis. We could never conceive a reason why an Act applicable to Little Peddlington or Eatanswill should not be applied to London. We fail to recognize in a Metropolitan Vestry any special virtue or talent which entitles them to be exempted from the control which is exercised over Provincial Boards. Our objection to this Bill goes to the root of the matter. We object to centralization altogether, within or without the Metropolis. At the same time, we may say that most of the alarm, and even indignation, expressed, is perfectly uncalled for. If we take the most obnoxious provisions—sections 85 to 88—it will be seen that most of them have been in the statute-book for several years; but no case has ever occurred in which they were put in force, nor, in our judgment, is any likely to occur. Public opinion in a district will always be sufficient to compel even a vestryman to do his duty. At this day, almost every metropolitan district has its local print—some two or more—and a local paper wields a power far greater than the Central Authority could exercise. We regard, then, the powers of compulsion, which the sections we have enumerated would confer, as altogether unnecessary, and, moreover, we doubt whether they could be enforced against a Vestry or District Board determinedly recalcitrant.

We imagine that, with the powerful opposition already organized, the Bill has no chance of success this year, and must be greatly modified to succeed at all. Some of our contemporaries remark on the slipshod manner in which the measure has been drawn; but we do not see much to complain of in this respect. We notice one section, however (the 30th), which will render a dealer liable to a fine of twenty pounds for "*every* "*animal, carcase, fish, or piece of meat flesh or fish,*" found in his possession, unfit for human food. Will any one calculate for us what amount an unfortunate fishmonger would be liable to if he were caught with a bushel of stinking sprats on his premises? Our Government departments, we fear, are failing in some of their functions, not the least important being the drafting of Bills.

Under the title of the "Public Health Act (1875) Amend-"ment Bill," a measure has been introduced to the House of Commons, which, we rather think, will create some dismay among many Rural Sanitary Authorities. It bears on the back, among others, the name of Mr. Cowen, M.P. for Newcastle, and, therefore, it would not, at first sight, be expected to aim at any centralization of authority. It will be found, however, that the promoters have adopted the 299th section of the Public Health Act, 1875, which is the same as the 85th section of the Public Health (Metropolis) Bill, against which the London Boards are now so strongly protesting. The object of the Bill, we notice, is clearly set forth in the second section, which is as follows:—"It shall be the duty of every Rural Sanitary Authority "to see that every occupied house within their district has, within "a reasonable distance, a supply of pure water sufficient for the con-"sumption and use, for domestic purposes, of the occupiers of the "house." Accordingly, they are to have power to compel every house owner to find such a supply, and they are not to allow any new houses to be built, or old ones to be rebuilt, before such a supply is provided. If the Rural Authority fail in this, their duty, the Medical Officer of Health may bring the Local Government Board upon them, with what consequences it is impossible to foresee. The county landlord interest is much too well represented in Parliament to allow of this measure passing into law, and we need not further refer to its provisions.

Contrary to our expectation, the Metropolitan Board of Works have decided to withdraw the Metropolis Floods Prevention Bill, rather than accept the amendments of the Committee of the House of Commons. The Committee have reported the Bill to the House, technically, without amendment; but their decision is certain to receive the attention of the Government, who will, probably, take up the measure, and proceed with it according to the terms of the Committee's report. Our own views upon this question have been repeatedly expressed, and we can only regret that a small majority of the Metropolitan Board have taken such a narrow view of a wide and important question.

The Coal Production of the World.—The coal production of the world is now estimated at 273 million tons. In this total Great Britain figures for 133 million tons; the United States for 46,500,000 tons; Germany for 45,645,000 tons; France for 16,950,000 tons; Belgium for 14,400,000 tons; and Austria and Hungary for 10,400,000 tons. The production of other countries is comparatively trifling.

CONTRIBUTIONS TO THE THEORY OF LUMINOUS FLAMES.

By Dr. KARL HEUMANN.
[Translated from the *Journal für Gasbeleuchtung.*]

PART I.

(*Continued from page* 491.)

Aided by the experience already gained, we now proceed to consider the disilluminating influence of the refrigerating burner, and of the following stream of cold gas.

It will at once be admitted that as a metal rod touching the flame, say, of a slit-burner, very near the burner-head, causes a rather considerable dark space within the flame, the head of the burner itself will also, by its refrigerating action, contribute to produce the non-luminous portion of the flame, which always exists, to a greater or less extent, immediately above it. But a second element—namely, the continued stream of cold gas—is also concerned in this result.

The disilluminating effect of the burner is naturally more conspicuous in small flames, for if the effect extends in a circle of, say, 0·5 centimètre radius, the proportionate loss will be greater in a small flame than in a larger and brighter one; moreover, in a small flame the diminution of light will extend over a greater space, because the actual temperature will not reach that of a larger flame, on account of conduction and radiation of heat, and also of excessive influx of air. The diminution of light may be carried to complete disillumination, if the flame of the slit-burner is reduced by nearly closing the tap. The refrigeration, too, is considerable, if the burner presents a large surface to the flame, and is made of thick metal, as in gas-stars, cooking apparatus, or gas-stoves, in which a number of small flames issue from a thick iron plate, perforated with very small holes. If the influx supply of gas is only small, all the flames are quite blue, and the lighting effect, so to speak, *nil*. I think it may, for the same reasons, be predicted that the heat of these cooking and stove burners, especially with small flames, must bear an unfavourable proportion to the gas consumed. If the supply of gas is increased with these burner arrangements, the tips of the little flames first become luminous; opening the tap wider, the light envelope of the much enlarged flame extends further downwards, but it never quite touches the head of the burner, the lowest portion of the flame always remaining blue.

If, then, the burner causes a diminution of light by its refrigerating action, it may, *à priori*, be asserted that this diminution will be greater with metal burners than with burners made of some bad conductor of heat. But an assumption hitherto made, that burners of porcelain or steatite possess advantages over metal burners, has been contradicted, and a competent practical authority informs me that in practice the only disadvantage of metal burners consists in their speedier oxidation.

This would lead to the conclusion that the greater diminution of light with a good conductor of heat, if perceptible at all, would certainly not be considerable. Only experiment could decide this. As it was evidently a question of very small differences in brilliancy, especial care was requisite in the choice of the burners, and I soon found that the ordinary burners sold in the shops would not fulfil my requirements. Two precisely similar burners were required, one made of steatite and one of iron, which should consume the same quantity of gas with equal openings of the tap; for, even with an equal consumption of gas, a larger hollow in the burner, or a different position of the tap might have a sufficient effect on the intensity of the light to entirely obscure that due to the material of the burner. I therefore had two special burners made, with heads of precisely the same size, and a circular hole in each, bored with the same instrument. These burners were luted on to glass tubes of equal diameter, and tested by the photometer under quite identical conditions.

The position of the tap remaining the same, the first observation showed that the iron burner consumed rather more gas than the steatite burner, but the excess was so slight that it did not prevent the greater brilliancy of light from the steatite burner being plainly perceptible:—

	Degree of Light in Wax Candles.		Consumption of Gas in Litres.
Steatite burner	0·90	...	36
Iron burner	0·85	...	37

It must, however, be remarked that the observation of the iron burner in this case, apart from the not inconsiderable errors due to the ordinary methods of photometry, were rendered much more difficult by the very perceptible variations, both of the intensity of the light and of the gas consumption, during the first minutes of combustion. This was evidently owing to the heating of the burner; the consequent alteration in the size of the aperture, and reduced rapidity with which the gas issued, were variable elements, which, it is true, would gradually attain an equilibrium, but would still differ in every case where the mode of consumption varied.

To obviate these disturbing influences, the iron burner was cooled down to 15° Cent. = 57° Fahr.—that is, retained at its initial temperature by a constantly renewed body of water, which was readily effected by passing the glass tube that carried the burner through a cork inserted in the top of a small bell-shaped glass, inverted till the orifice of the burner was on an exact level with the lip of the bell. This funnel-shaped vessel was then filled to the brim with water, so that the iron burner was surrounded by water. A funnel tube above the vessel, and an exit-pipe, allowed the upper layer of water to be constantly renewed as fast as it grew warm.

The experiments, of which the result is given in the following table, were carried out by causing the gas* first to pass through a meter, the index of which read per minute showed the consumption in litres per hour. The readings of the gas consumed in the flame to be tested were taken by setting a seconds teller in motion at the moment when the index of the meter pointed to a division; the position of the index was again noted when the timekeeper showed that one or more minutes had elapsed. For protection against errors or unforeseen chances, I always took several readings both before and after using the photometer. The standard was the light of a stearine candle, according to which the gas-flame was regulated in the moveable disc-box; here, too, I always, after the measurement, tested whether the gas-flame still equalled the candle, and in each case I took several observations on the photometer with the flame under examination. The gas pressure was in every case 3 inches of water.

All the photometric observations, including those given further below, were carried out in this manner. Of course, only those figures admit of comparison which resulted from experiments immediately following each other; for the quality of the gas, as was proved by direct experiment, varied a good deal at different times.

STEATITE BURNER.				IRON BURNER.			
Light in Candles.		Gas Consumption in Litres.		Light in Candles.		Gas Consumption in Litres.	
	Average.		Average.		Average.		Average.
0·12	0·12	14·5	14·6	0·16	0·17	19·5	19·5
0·12		14·7		0·18		20·0	
				0·17		19·0	
						19·5	
		22·0		0·30	0·30	25·5	25·7
0·30	0·30	21·0	21·3	0·30		26·0	
0·30		21·0		0·30		25·5	
0·90	0·96	39·0	39·0	0·90	0·87	41·0	41·7
1·00		39·0		0·80		42·0	
0·98		39·0		0·90		42·0	

It was not advisable to increase the flow of gas any further, as the different portions of the flame, in consequence of its length, would no longer have been equi-distant from the diaphragm, and any consequent error would have been the more serious, because the weak light of the flame necessitated its being pretty close to the diaphragm.

The second and third groups of figures in the above table show at a glance that the steatite burner had a decided advantage, as for equal intensity of light less gas was required than with the iron burner. In the first group this is not so evident, and, in fact, if from the 14·6 litres and 0·12 light the proportion were calculated for 19·5 litres consumption for the steatite burner, the result would be rather against it as compared with the iron burner; but if the figures obtained in the experiment with one burner are tested against each other, it will be found that they are not at all proportional, but that the light of very small flames is much below the figures that would be arrived at from a proportion based on the result of experiments with a larger gas consumption. This probably arises, in the first instance, from the refrigerating action of the burner, but the loss of heat by conduction, radiation, and excess of air is greater in a small flame than in a larger one.

The results of the above table are more clearly shown if the intensities of light are considered as ordinates, and the corresponding gas consumption as abscissæ in a system of co-ordinates, the appearance with increased gas consumption being represented by a curve. The curve of the iron burner is much below that of the steatite burner.

It cannot now, therefore, be asserted, that the advantages of a slow-conducting material for burners are "altogether imaginary." In the above case the advantage was not inconsiderable, chiefly, it is true, because the iron burner was kept at its original cold temperature by artificial means. Of course, a burner acting without such a cooling apparatus would heat very quickly, and attain a pretty high temperature. That the disadvantage of an iron burner is thus much lessened, and that especially with a very bright flame, it might not exercise any very perceptible influence on the intensity of the light, is easily understood; but I think my experiments have established the fact that there is a greater diminution of light with metal burners.

The refrigerating influence of a metal burner may be shown in other very instructive ways. If a cooking burner, or metal single-hole burner, is closely observed immediately after lighting, it will be seen that a wet spot is formed close round the aperture. In small flames, after burning for a short time, the condensed water becomes mixed with tarry matter, which rapidly increases to a considerable quantity if the burner is kept cool by artificial means. A thick drop of tarry liquid soon collected round the aperture of the well-cooled burner used in the above experiments, and threatened to stop it up. But if the burner is not cooled it gradually heats, and the condensed water is again evaporated; a brown residuum from the dried tar remains, however, on the upper surface of the burner, as a visible proof of the great abstraction of heat effected at first by the burner.

It has been already shown that a wire inserted in a flame disilluminates it to a considerable extent, but that if the wire be glowing hot, no such disillumination takes place. By the same rule, the diminution of light occasioned by the refrigerating effect of a cold burner will cease when the latter is heated to glowing.

Unfortunately, in this experiment, it is impossible to prevent the gas-stream from becoming heated also; so that the result, which entirely confirms what is said above, cannot be exclusively referred to the cessation of heat-abstraction by the burner.

The refrigerating effect of the cold gas-stream on the already

* The gas-works here furnish a mixture of wood and coal gas.

glowing gases—*i. e.*, the flame—has been already noticed in speaking of the space between the flame and the burner when compressed gas is used. As it is now also established that the light is diminished by cooling the flame, the same effect must also be produced by the freshly-inflowing gas-stream.

If we suppose that the flame could exist for a moment without the continual influx of fresh gas, it would not, even in this case, be of the same temperature throughout; as the impenetration of air, as well as conduction and radiation, would cause the outer portions of the flame to lose most heat; the hottest part would, therefore, be somewhere about the centre of the flame. If we now suppose cold gas suddenly to enter at the bottom of the flame, it is clear that the greatest diminution of heat will take place in the lower interior portion of the flame; the hottest part is, therefore, no longer in the centre, but must have moved further up, nearer the tip of the flame.

But the different portions of the flame have all to participate in this reduction of heat, and those parts the temperature of which was previously only a little above what was absolutely necessary for the separation of carbon would be cooled below this point—*i.e.*, entirely disilluminated by the refrigerating effect of the gas-jet, while intrinsically hotter portions of the flame would only suffer a diminution of light. The colder the intruding gas is, the more will the entire light of the flame be weakened, consequent upon the joint action of all these causes, while it will be very greatly increased, and even reach the intensity of the above hypothetical flame existing without the influx of gas, if the heat-abstracting effect of the issuing gas-stream is obviated by heating it to the flame temperature before it is allowed to enter.

(To be continued.)

COMMON SENSE FOR GAS USERS.*

Notwithstanding that this is an interesting and highly useful work in many respects, the exercise by the author of a modicum of the common sense which he has endeavoured to instil into the minds of gas users would have led him to omit, or to have treated in a different manner, several matters that do not by any means improve the quality of the book.

For instance, the often refuted statement of the formation of sulphuric acid in the combustion of coal gas is reproduced with a good deal of dogmatic assertion, which, considering that Mr. Wilson is an engineer, and not a chemist, is scarcely becoming.

A great amount of attention and inquiry have again recently been devoted to the sulphur question, and he can scarcely be other than prejudiced, who, after carefully perusing the evidence for and against, arrives at any other conclusion than that it is entirely a question of ventilation; and that the destruction of certain textures, the canvas of pictures and their frames, and the bindings of books, is due not to the formation of sulphuric acid, but to the desiccating effects of heat in the upper stratum of the air of badly ventilated rooms lighted with gas.

Again, in speaking of the desirability of consumers being able to read their own meters, the author gives an absurd example of the "carelessness, or worse, on the part of the gas company's servants," caused by the consumer not keeping a record of his consumption. "In a large manufacturing town, the owner of an extensive warehouse formerly had his place lighted with gas, but, in consequence of a dispute with the gas company, had the gas shut off at the main. To his surprise the gas account was rendered the following quarter as usual, and for about the same amount as had hitherto been the rule. On remonstrating with the gas company about the absurdity of the charge, they asked him to pay what he considered fair. Had this consumer been able to read his own meter, he would have been able to check the quarterly account regularly, and would not have run the risk of being imposed upon. In this case the gas company had erroneously assumed the meter had been passing gas without registering, and acted accordingly."

We fail entirely to see the relevancy of the example adduced; besides, its puerility should have ensured its rejection. Such stories in derogation of gas suppliers may be collected by the bushel, but we never knew an instance of a single one of them being verified on investigation. Statements like this are better spared. Both companies and local authorities supplying gas have to contend against sufficient prejudice without a writer of note furbishing up the gamut of grievances retailed against them by unjust or unreasonable consumers.

Then, as to the "simple means of testing a meter," recommended on pp. 44 and 45, what do our readers think of this? "Obtain a large jar, of glass, if possible, of which the exact cubic contents in feet and in inches is easily calculated. As there are 6¼ gallons, or 25 quarts, in a cubic foot, a gallon jar filled 25 times, or a quart jar filled 100 times, will represent 4 cubic feet. Fill the jar with water, and cover it with a flat plate of glass or other material. It can now easily be reversed without spilling its contents, and placed mouth downwards in a flat pan or trough containing 2 or 3 cubic inches of water. So placed, the atmospheric pressure will keep the water in the jar. Having unscrewed and severed the connexion between the house supply-pipe and the meter, attach a piece of india-rubber pipe to the meter, having a stop tap at the end with an elbow to it. Turn on the gas till this pipe is filled, and note the position of the small hand on small index on the meter. Carefully place the pipe under the jar without allowing the water to escape, and turn on the gas, which will bubble up and displace the water. As soon as all the water is forced out and the jar is full of gas, turn off the gas at the tap. Repeat the experiment again and again until the number of fillings, multiplied by the contents of the jar, equal, say, 4 or 8 feet of gas. On comparing this with the consumption indicated on the meter, its accuracy or otherwise will be seen. It is advisable to allow a slight margin in favour of the meter index, to compensate for any inaccuracy on the part of the tester.

"Another and simpler mode of testing a meter is to use a cask or other water-tight vessel, having a capacity of several feet, which can be accurately ascertained by measuring or weighing the water required to fill the vessel. The outlet-pipe from the meter being connected with the top of the vessel when filled with water, and the gas being allowed to enter the vessel as the water flows out at the bottom, at the moment the water ceases to flow the vessel will be filled with gas, the amount of which being known, can be compared with the quantity registered during the test by the meter." The author might well prefix the remark that "some skill in manipulating the simple apparatus, and considerable patience, is necessary."

Such a mode of amateur testing, with all its inevitable inaccuracies, could only lead to bickerings between user and supplier, and possibly also to accidents of a serious kind. But even if such a system of testing could be relied on, *cui bono*, so long as practical meter testers are accessible, whose certificate may be accepted without hesitation? Such a method of experimenting should not be recommended, or even mentioned, in a work proposing to teach common sense to its readers. No sensible man would attempt any such folly in the way of experimenting, and a reckless or foolish person should not be encouraged to risk either his own or his neighbour's property and life.

There is surely an inconsistency in the statement on pp. 47 and 48 with reference to the comparative merits of wet and dry meters. The question is asked, "What advantages has the dry meter over the wet meter?" and the reply is given under a series of heads, laudatory of the dry meter, with some of which we do not agree. After this comes the further question, with its answer: "Then why are dry meters not always used?" "Because, until recently, there has been a strong prejudice on the part of the gas companies against their use. It was considered that they were too delicate to answer well or last long, that they could not be easily tested, and that, as a rule, they told against the gas company—that is, they registered less than the actual quantity of gas that passed through them. The prejudice is now rapidly dying out, and as the stocks of wet meters held by the gas companies disappear, they are largely replaced by dry meters."

"Is the dry meter as trustworthy as the wet meter?" "No; it is too delicate in its construction, and as the flexible leather inside is liable to stiffen in course of time, the dry meter cannot be depended on to register accurately for more than from two to five years. Hence it is considered necessary by gas companies to re-test the dry meters every few years."

If the description as to the untrustworthy character of the dry meter, after a few years use, be correct, the objections on the part of the gas companies to its employment can scarcely be described as mere *prejudices*. If a meter cannot be depended on to register correctly for more than two years, the objections to its employment are perfectly natural and just. It is well known, too, that dry meters, like wet meters, notwithstanding Mr. Wilson's assertion to the contrary, *are* liable to stoppage by frost, owing to the moisture present in them after working for a time; and it is certainly not correct to say that wet meters are being gradually supplanted by the dry. We have reason to know that dry meters are less in favour now than they were ten or a dozen years ago.

Speaking of service-pipes, the author states that in this country wrought iron alone is used for service-pipes. This is a mistake. Lead pipes are used almost exclusively in some of our large towns, and in many places, particularly in Scotland, cast-iron service-pipes are employed.

We have been thus careful to point out what we consider defects in a work that will probably command a wide circulation, from the well-known ability of the author, and the repute of the publishers for producing works of a scientific character. In future editions some of the matters referred to should be eliminated, and the others corrected. We despair, however, of consumers in the bulk availing themselves of the excellent advice offered on nearly every page of the book. They will, as a rule, be content to go on in the old groove, and have their grumble against the gas and the company as before.

Of trustworthy information on the subject of gas lighting there is no lack; the difficulty is to get consumers to acquire it, and act upon it. There are many useful manuals, written in a popular style, by gas engineers and others, dealing with the question; and some of them have been placed under the very noses of those concerned; but, in spite of this, there is no subject on which so much ignorance prevails, and in regard to which there is greater carelessness or indifference manifested.

The truth is, a certain measure of scientific knowledge, physical and chemical, is required in a consumer, to induce him to enter heartily into the matter with a view to introducing the remedies necessary; and this the average householder does not possess, and scarcely cares to acquire. The effort to understand the conditions under which gas is most economically consumed would give him too much trouble. The bulk of mankind have no taste for practical science; it is only the actual student, or the curious in such matters, who avails himself of the advice so freely offered. For the many, martyrdom, in short, is pleasanter to contemplate, and easier to bear, than the thought of penetrating the mysteries of gas illumination, or even of registration.

A school for the education of gas-fitters in the theory of gas lighting is needed in every large town; and if that class could be brought under the influence of such teaching as could readily be

* "Common Sense for Gas Users. A Catechism of Gas Lighting." By Robert Wilson, C.E., author of a "Treatise on Steam-Boilers." London: Crosby, Lockwood, and Co., 1877.

supplied to them, more would be done in the way of improved gas consumption than will ever be accomplished by any treatise, however popularly written and accessible in point of price. Consumers are greatly at the mercy of gas-fitters, as Mr. Wilson shows; and till these are educated into their duties, or until the gas suppliers themselves take the fitting into their own hands, the grievances of consumers will continue to exist.

The book, Mr. Wilson says, is not written for gas-works engineers, but for gas-fitters, consumers, and others, the exercise of whose skill should begin where the work of the gas company's servants usually ends. Had it been the practice of gas companies to continue their work to the burners, the book might never have been written. Nevertheless, there are managers of gas-works who may profit by a careful perusal and study of the facts and advice it contains.

Given an adequate supply of good gas, at a cheap rate, how can it best be utilized for lighting purposes? This is the problem the author has endeavoured to solve in a popular manner, and with very considerable success. The work is written in the form of a catechism, and is divided into eleven chapters, and an appendix on gas-engines, the illustrations accompanying them being numerous and neatly executed. The subjects treated of are the nature and qualities of gas, the advantages and disadvantages attending its use, gas-fitters, meters, gas-pipes, burners, gaseliers, globes, regulators, and carburizers. In each chapter there is much valuable information, and some originality; and the treatment of the subjects throughout is clear and concise.

Correspondence.

[We do not hold ourselves responsible for the opinions expressed by Correspondents.]

THE VALUATION OF GAS LIQUOR.

Sir,—The communication from a correspondent upon the above subject, published in this day's Journal, is somewhat late in the day. It is now some twelve months since the little apparatus described was fitted up for the Phœnix Company, with a view to meet a special difficulty. As your correspondent truly says, there is little novelty in it; none was ever claimed, but in one or two matters of detail it fulfils its purpose more satisfactorily than most other forms of apparatus fitted up for the same application. I have not had the pleasure of seeing, or hearing of, Mr. Hartley's recent pamphlet.

Thos. Wills.

Royal Naval College, Greenwich, June 19, 1877.

MR. GLADSTONE ON THE TRANSFER OF GAS AND WATER WORKS TO CORPORATIONS.

The following correspondence has been forwarded to us for publication:—

The Right Hon. W. E. Gladstone, M.P., &c.

Sir,—I must apologize for the liberty I take in asking you a question which arises out of your reply to Mr. Silverthorne. It relates to the appropriation of the net profits of gas undertakings in the hands of local authorities. Mr. Silverthorne has correctly told you that since the gas undertakings have been in the hands of the Corporation of Birmingham, £25,000 of net profits have been paid over to the borough improvement-fund. The question I would ask you shortly is, whether or not such an appropriation of the profits must not be regarded as an addition to the taxation of gas consumers? Bearing in mind (1) that all ratepayers are not gas consumers, (2) that the largest ratepayers are sometimes very small gas consumers, and (3) that large ratepayers are often large consumers of gas, I think you will see that in two cases gas profits applied to public purposes go to relieve rates at the expense of the gas consumers, and, in the third case, involve a direct injustice in the shape of a double taxation.

You will, of course, know that in the cases of most Scottish Burghs possessing gas undertakings these are conducted on what I may call the "self-supporting system;" that is, that the charges for gas are fixed so as to exactly balance the expenditure. To this system, I take it, no objection can be raised; but I contend that the English system of making profits (enormous in the case of Manchester) to be applied to public improvements constitutes a double taxation of the consumers of gas.

And here, but that I do not wish to take up more of your valuable time, I might refer you to a statement of the late Mr. J. S. Mill ("Principles of Political Economy," Book V., chap. v., §4) in which he lays it down as an important principle that a rate (and people always regard the charges made for gas and water as rates) levied by a local authority for a special service should never exceed the expense incurred in rendering such service.

Since the matter I venture to bring before you is of great importance to the ratepayers in many of our large corporate towns, and is likely to become of more importance as the transference of undertakings progresses, I have ventured to ask your opinion as to the appropriation of profits from the point of view above mentioned, and am, with much respect,

Your obedient servant,

W. T. Fewtrell.

13a, *Great George Street, Westminster, June* 21, 1877.

W. T. Fewtrell, Esq.

Sir,—In my note of the 13th, I certainly had in view the economy of production through consolidation of undertakings, and did not at all refer to the transfer of profits from one local purpose to bear the charge of another.

Mr. Mill's principle is undoubtedly, in my view, sound. It would not, however, follow that the rule is to be absolutely without exception. The presumption would, of course, be against the exception, but it would be unwarrantable in me to attempt to determine any case without an exact consideration of the circumstances, such, as I fear, I could not undertake.

I remain, Sir, your faithful servant,

73, Harley Street, June 22, 1877. W. E. Gladstone.

DOUBLE OR SINGLE STAND-PIPES.

Sir,—Gasholders are, without exception, provided with two stand-pipes; but I venture to ask if a single pipe—the outlet—would not be sufficient, if the inlet were connected to it before its entering the stand-pipe well, fixing, of course, the slide valves before the junction.

By omitting the second pipe the well may be reduced in diameter, and the difficult fixing, and the chance of leakage and breakage which exist, though they seldom occur, are reduced by half.

It is true that, compared with the enormous capital often spent in gas-works, the saving would be a trifle; but why throw away even a single pound if no advantage whatever is derived from it? It may be the two pipes are of some service in small works which have to use cannel, as they promote, in some degree, the mixing of the gas made in the evening with the contents of the holder; but for large works, where at sunset a number of them are filled and ready for delivery, I cannot see the two pipes are of any use whatever.

Is there, however, a valid reason for their employ of which I am ignorant? I shall be glad to be informed of it in the columns of your valuable Journal, of which I am a constant reader.

A Dutch Manager.

BRITISH ASSOCIATION OF GAS MANAGERS.

Sir,—Permit me to correct an error which appears in the otherwise very excellent report of the meeting of the British Association of Gas Managers, held in Bristol last week. At p. 1007, Mr. Johnson, of London, is represented as having been elected consequent upon the discretionary power given to the committee. This is not so. Mr. T. C. Hersey, of London, was the only gentleman so elected; but as Mr. Johnson was the proposer of Mr. Hersey, and his name was read to the meeting, I can quite understand such a mistake creeping in. Mr. Johnson joined the Association in 1868.

W. H. Bennett,
Secretary of the British Association of Gas Managers.

22, *Great George Street, Westminster, S.W., June* 23, 1877.

STANDARD PRICE OF GAS.

Sir,—A man with a grievance is generally considered to be a bore; I hope, however, I may not be so considered by yourself or your readers, now that I have a grievance to ventilate.

On a very recent public occasion I stated, when reviewing the gas legislation of the present session, that the companies promoting Bills, whether opposed or unopposed, have had no cause of complaint in regard to the application of the new "Standing Order," a fair margin having been allowed in fixing the "standard price." This was true up to the early part of last week.

Since then, however, my experience has not been so pleasant; one unopposed Bill, of which I had charge, having passed satisfactorily through a committee of one House, with a margin of 4d. per 1000 feet allowed between the present price and the "standard price" granted by the committee, when it came before the committee of the other House, the "standard" was cut down, without rhyme or reason, and in the teeth of sound argument, to the price charged by the company at the time they came to Parliament for statutory powers, thus leaving the company no margin whatever, depriving the shareholders of the old and accustomed privilege of a *pro ratâ* allotment of new shares among themselves, and giving them nothing in its place, which was one of the proposed objects of the sliding scale.

The effect of such decisions as this, if they should become common, will be to deter companies from lowering the price of gas on the eve of going to Parliament, and so inflict injury on the consumers of gas instead of conferring a benefit upon them.

All companies in such a position will do well to reflect that "to be forewarned is to be forearmed."

R. P. Spice.

21, *Parliament Street, Westminster, S.W., June* 25, 1877.

Miscellaneous News.

PLYMOUTH AND STONEHOUSE GAS COMPANY.

The Annual Meeting of Shareholders was held on Thursday, the 21st inst.—Mr. P. Adams in the chair.

The Secretary (Mr. G. Henderson) read the following report of the directors:—

The directors, in presenting a statement of accounts for the year ending March 31, 1877, have the satisfaction to assure the shareholders of the continued prosperity of the company.

After providing for outstanding liabilities, and payment (in January last) of the authorized half-yearly dividend, there remains a disposable balance of £6408 13s. 1d. Your directors, therefore, recommend the payment of a further dividend of 10s. per share on the original shares, 7s. 6d. per share on the additional shares, and 3s. 9d. per share on the new additional shares, and that the balance of £2908 13s. 1d. be carried forward to the credit of next year's account.

It has always been the policy of your directors to reduce the charge for gas as early as, in their judgment, circumstances would justify such a step. In anticipation of the financial results of the year, they determined, in February last, notwithstanding the reduction made last year, to announce a further reduction of 2d. per 1000 feet to private consumers, and 4s. per lamp per annum for public lamps, to commence at Lady-day; and it is satisfactory to find their expectations have been fully realized.

The retort-house and coal stores, referred to in the last report as then in course of reconstruction, were completed in time for use during the past winter. The new purifiers are nearly completed, and will be available for the coming winter. After being in action for several years, the gasholders Nos. 2 and 3 are found to be in a defective condition, and it is necessary that the crowns be renewed forthwith. To meet this outlay, the directors have carried the sum of £2000 to a contingent-fund.

The directors have to regret, since they last met the shareholders, the loss of one of their oldest colleagues in the person of the late Mr. William Burnell, whose sound judgment rendered him at all times welcome amongst them, and his place at the board has been filled by the appointment of Mr. Samuel Jackson.

The retiring directors are Mr. James Payne, Mr. Richard Rundle, Mr. Isaac Watts, and Mr. John May; the three former, being eligible, offer themselves for re-election. In consequence of severe affliction Mr. May does not seek re-election, and the directors regret they are thus deprived of the able services of one who has been a member of the board from the formation of the company. The retiring auditor, Mr. John Turner, is eligible, and offers himself for re-election.

The Chairman moved the adoption of the report, and congratulated the shareholders on the flourishing position of the company. Of course, they got a little blame occasionally; it was incidental to the working of such a large business; but he did not know any town in England where gas was so cheap as at Plymouth. The quality of the gas was very good, and oftentimes, when complaints were made, the fault was not in the gas, but in the fittings. During the last year there had been a great deal done on the

premises. The old retort-house had been pulled down, and a new one had been erected, and worked very well. Whilst the old house had 12 benches, the new one had only 10, and, therefore, it was not an extension but a renewal. There were four very large purifiers, but they were not yet finished. All that could be done to further purify the gas would be done.

Mr. R. RUNDLE seconded the motion, which was carried unanimously.

The CHAIRMAN moved the payment of a dividend of 10s. per share on the "original shares," 7s. 6d. per share on the "additional shares," and 3s. 9d. per share on the "new additional shares."

Mr. J. PAYNE seconded, and the motion was carried unanimously.

The CHAIRMAN moved the re-election of the retiring directors, which was seconded by Mr. PETERS, and carried.

Mr. R. H. Snow was elected a director in the place of Mr. May, and Mr. Turner was re-elected auditor.

The CHAIRMAN made a few remarks on the use of gas-stoves and fires. He had had a gas-stove in use for upwards of 20 years, and in this everything was cooked, both in winter and summer. The great secret in the economical use of these stoves was the education of their servants in turning off the gas when it was not required. He also had a gas-fire in his bed-room, and both the stove and fire were very economical.

Mr. WATTS remarked that gas used in a proper manner would not cost half what coals would.

The CHAIRMAN, in answer to a question, said his gas bill was not £1 per quarter.

Mr. BROWNING said that nothing injurious emanated from gas as there did from coal or coke.

Mr. PILLMAN asked whether the directors had under their consideration the advisability of either reducing the rental of the meters or doing away with it altogether. They got a large profit on the meter-rent, and it would be a gratification to him if they could reduce the rental or abolish it. He considered that the fact that the directors had spontaneously made a reduction in the charge for public lights, by which ordinary consumers and the ratepayers generally benefited, should not be overlooked.

The CHAIRMAN said that the meter question had been before the directors again and again, but they could not see their way clear to make an alteration. One of the best companies in the world—he referred to the South Metropolitan—did not for years charge for the loan of meters, but now they had done so, besides adding 2d. to the price for gas. That company were now charging 3s. 2d. per 1000 feet of gas, besides the meter-rent.

Mr. PILLMAN drew attention to the item of the interest on their unemployed capital, which was stated on the balance-sheet to be £330. This appeared to him to be a very small interest, considering that their unemployed capital was between £14,000 and £15,000.

Mr. R. WOOLLAND remarked that there was a large number of small consumers in the town, and if the meter-rent were taken off the bills of these consumers, they would pay next to nothing. He was pleased that the directors came forward spontaneously and lowered the price for the street-lamps, as it enabled the Town Council to devote more money towards macadamizing and pitching their streets—a work that was greatly needed. He proposed a vote of thanks to the chairman and directors for the manner in which they had performed their duties.

Mr. PILLMAN seconded the motion, which was put and carried; and the CHAIRMAN and Mr. RUNDLE acknowledged the compliment, the latter remarking, with regard to the meter question, that he believed Mr. Woolland had struck the right nail on the head when stating that if it were abolished large consumers would have the small sum of 10s. taken off, and small consumers would pay hadly anything.

The SECRETARY pointed out that a large number of consumers had 30-light meters, for which they had to pay 5s. If three men burned—one, 14,500 feet, at a cost of £1 16s. 3d.; a second, 166,000 feet, at £21 2s. 3d.; and the third, 354,000 feet, at £32 1s. 9d., the man who burned the last amount would get only 5s. if meter-rents were abolished, the same as the man who burned £1 worth. This, in his opinion, would entirely be for the advantage of small consumers only.

The meeting then separated.

NORTH SHIELDS WATER-WORKS COMPANY.—The annual meeting was held on the 18th inst—Dr. Bramwell in the chair. The report stated that since the last annual meeting 196 services had been laid in to supply 281 new consumers, being a considerable increase over the last two years. The gross revenue for the year was £7384 4s., and the expenses £5173 9s. 5d., leaving a balance of £2213 14s. 7d., and adding to which £283 8s. 1d., the balance after paying the dividend last year, and various items, as shown in the accounts, made a total of £2497 2s. 8d. to the credit of profit and loss account. Out of this sum the directors recommended a dividend of 5 per cent., which amounted to £2000, to which must be added the sum of £20 10s. 8d. due to the Duke of Northumberland, being his one-seventh share, and after paying these amounts a balance would remain of £476 12s. to the credit of profit and loss account.

VISIT OF GAS MANAGERS TO CHELTENHAM.—On Friday, the 15th inst., a number of members of the British Association, including Messrs. Spice, Woodall, Morton, and Bennett, of London, Warner, of South Shields, Hunt, of Birmingham, Woodall, of Leeds, and others, availed themselves of the invitation of Mr. R. O. Paterson to make a flying visit to Cheltenham, principally with the object of examining the working of the jet exhauster. The party were conducted, immediately on their arrival at Cheltenham, to the works, and the principal matters of interest pointed out by Mr. Paterson. The system of carbonization by Spinney's ovens, without the intervention of the hydraulic main, was closely inspected, and the action of the jet exhauster, drawing the gas from the ovens at a level and perfectly steady gauge, created much interest. After examining the arrangements being made for the permanent adoption of the steam-jet, the party were entertained at luncheon by Mr. Paterson. Here they were joined by Mr. Skillicorne, the recently-elected first mayor of Cheltenham, who is also chairman of the gas company. Mr. Spice, in a few well-chosen sentences, proposed as a toast, "Success to the Cheltenham Gas Company," and congratulated his worship on the excellent condition of the works, which, he said, their inspection had shown them were conducted on the most modern scientific principles. After an appropriate reply from Mr. Skillicorne, the health of Mr. and Mrs. Paterson was proposed by Mr. Woodall, and acknowledged by Mr. Paterson, who stated that his object in drawing together a few of his fellow-members had been partly to carry out what he felt sure would have been done by his predecessor, Mr. Esson, who, there was no occasion to remind them, had always taken the warmest interest in the affairs of the Association, and partly to encourage that recognition of the merits of the Association which he considered it the duty of each individual member to promote. After doing justice to the good things provided for their repast, the party were conveyed in a brake through some of the principal streets of this fashionable inland watering-place, and thence along the side of the Cotteswold Hills (from whence the most charming views of the valley of the Severn are obtained) to Birdlip. After a short stay at the village, a further delightful drive was made, *vid* Cranham Wood, to Gloucester, where the party separated for their respective destinations, highly pleased with the pleasant addition thus made to the Bristol meeting.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 1008.)

TUESDAY, JUNE 12.

Mr. R. O. PATERSON (Cheltenham) read the following paper:—

EXPERIENCE OF KORTING-CLELAND'S STEAM-JET GAS-EXHAUSTER, WITH NOTES ON ITS ADAPABILITY AND ECONOMY.

It is with some hesitation that I come before you to treat of the subject which stands at the head of my paper. The novelty of the subject, and the solicitation of many friends, while probably presenting a sufficient excuse for attempting the work, only adds to the anxiety and fear that I may not do it that justice which it deserves.

Being under the necessity of soon having to provide larger exhausting apparatus, my attention was forcibly drawn to the steam-jet, after hearing the admirable paper read by Mr. Cleland at the Association's meeting at Leeds in 1875. The change from the ordinary mechanical exhausters to a system such as this was felt to be of too radical a nature to be adopted without careful investigation, and it is principally a record of these investigations I propose laying before you.

In April last year I had a No. 16, capable of passing 60,000 cubic feet per hour, fixed on the outlet of the scrubbers, and fairly tried. I feel it to be unnecessary here to say anything about the instrument considered simply as a medium for relieving the retorts of what is technically known as "back pressure;" as the principle of its action is well known, and similar contrivances have been successfully used for analogous purposes in other manufacturing processes for a considerable time. It is sufficient to say that, in this respect, the steam-jet performs its work in a most admirable manner. The pressure-register paper lying on the table shows a fair average day's performance, and is a sufficient proof of the excellent work which may be done by it. No oscillatory movement is discernible—indeed, the exhaustion is done so steadily that the pointer of a King's gauge, indicating 1-100ths of an inch, can hardly be observed to move. But it is necessary to say that there was no hydraulic main, nor any hydraulic seal, interposed between the retorts and the exhauster in this case; and it is not at all likely that such regularity can be obtained where the hydraulic seal exists, nor, under any circumstances, without the close personal attention of the man in charge, any more than it could be by the use of the best mechanical exhauster known to us at the present time. The governor usually supplied with the exhauster is far from being sensitive enough for the purpose of economical exhaustion, which may be shortly described as consisting in obtaining a steady and unvarying pressure.

The gas and steam, after passing through the exhauster, were cooled in a horizontal condenser, composed of 326 feet of old 14-inch mains, which were in stock at the time, laid conveniently in an open space in the yard. The superficial cooling surface, including a small boiler, filled with rubble intended to catch and throw down any tarry particles that might be in suspension, was 1381 square feet. The gas, after this, entered a couple of washers of a new design, which had previously been used after the old exhausters for the absorption of carbonic acid, and into one of which the condensed steam was pumped. With an average hourly make of gas of 11,400 cubic feet, giving a condensing surface of 121 square feet per 1000 feet per hour, it was found that with the temperature of the air in the shade at 55°, and that of the gas entering the exhauster at 68°, the steam could not be thrown down, nor the gas cooled below about 100°, notwithstanding that the pipes were at the time protected by bags from the direct rays of the sun. The effect of this high temperature was to expel the ammonia from the strong liquor in the washer, and render the gas more impure in this respect after leaving them than it was before it entered. On this account, after about a month's work, operations had to be suspended until sufficient condensing surface could be provided. The experience gained in this short period was valuable, inasmuch as it revealed an action which, unless understood, would be sure to create a difficulty—namely, the conversion, by the heat of the steam, of the most volatile constituents of the tarry particles, held in mechanical suspension in the unpurified gas, into a gas of a more or less permanent character, leaving a residue of pitchy matter, of which this bottle [produced] contains a sample. This deposit is found to occur immediately on the outlet of the exhauster, where the temperature averages 143°, but is never found under 120°, at which temperature it is of a semi-liquid character. Fortunately, in the temporary condenser at about 120°, there was an open syphon-box, designed to draw off a portion of the condensed steam, where the pitchy matter was arrested and removed before reaching the cooler pipes, in which, no doubt, it would have ultimately presented a very awkward obstruction. This deposit was altogether unexpected, and, to my knowledge, hitherto unknown in connexion with the steam-jet exhauster. It was the more surprising as it occurred with a gas previously thoroughly condensed, and copiously washed and scrubbed with ammoniacal liquor.

In recounting the experience of this first trial, I have not said anything about the consumption of steam, because no satisfactory test was made. It was attempted several times, by gauging the condensed steam flowing from the pipe; but the results were variable, and manifestly unreliable. From the fact that the boiler, working the mechanical exhausters, was found to be inadequate to generate sufficient steam for the jet, there was a pretty clear indication that the quantity required was larger than had been stated; and more than is required by steam-engines. Incidentally I may mention here, as a lesson learnt from experience, that it would always be advisable to have the boiler as near as possible to the exhauster, otherwise the condensation of the steam, however small, unless removed from the pipes, will interfere with the free working of the exhauster, and cause an unsteady action. It is also advisable to fix the steam throttle-valve in a vertical position to prevent any water, condensed from the steam, accumulating behind the contracted aperture, which accumulation would be periodically displaced, causing an unsteadiness in the exhaustion.

After an interval of some months, during which time an additional condenser and a duplicate jet exhauster were put up, with the view of carrying on the experiments throughout the winter, a fresh start was made in October, since which time the steam-jet has been almost continuously at work. The additional condenser was fixed near the end of the horizontal 14-inch pipe, and consisted of 18 9-inch vertical pipes 18 feet high, down which the gas flowed from an upper to a lower chamber, where it is drawn off. Even with the addition of this condenser, which made the total superficial cooling surface 2541 square feet, or about 63 square feet to each 1000 cubic feet of hourly make of gas in mid-winter, the temperature could not be got below an average of 79°, under the most favourable conditions, at the entrance to the washers, formerly mentioned, and in which it was ultimately cooled to about 60°. In the washers a new and most unexpected difficulty arose, namely, a rapid deposition of naphthaline salts, the more unexpected, as hitherto naphthaline was unknown on the works.

I append a table compiled from the results of an experiment made in April this year, extending over five days, of which I will read the averages:—

—	Gas Made.	Back Pressure of Gas.	Exhaust.	Total Resistance to Exhaust.	Total Water Used in Gallons.	Water Used to Exhaust 1000 Cubic Feet of Gas.	Steam Pressure.	Temperature (Degrees Fahr.). Gas Entering Exhaust.	No. 1. Outlet of Exhaust.	No. 2. 41 Feet from Exhaust.	No. 3. 206 Feet from Exhaust.	No. 4. 336 Feet from Exhaust.	No. 5. Vertical Condenser.	No. 6. Inlet of Washer.	Air.
	Cubic Feet.	Inches.	Inch.	Inches.			lbs.								
April 9–10, 1877. . .	458,000	11·7	..	..	896·3	1·957	53·2	61	142·0	137·0	123	108·0	90·0	78·0	53·0
April 10–11, „ . . .	395,000	10·9	..	..	709·0	1·772	52·5	63	143·0	137·0	119	103·0	84·0	76·0	56·0
April 11–12, „ . . .	410,000	12·0	..	..	805·5	1·964	52·7	62	144·0	137·0	120	103·0	76·0	66·0	50·0
April 12–13, „ . . .	433,000	11·6	0·60	..	891·9	2·060	52·9	60	144·0	136·0	119	101·0	75·0	67·0	49·0
April 13–14, „ . . .	442,000	11·4	0·80	..	798·9	1·808	52·0	60	143·0	135·0	119	102·0	82·0	71·0	51·0
	2,138,000	11·5	0·85	12·35	4101·6	1·918	52·6	61	143·2	136·4	120	103·4	81·4	71·6	51·8

During the whole of the five days over which the experiment lasted, the sky was continually overcast, presenting very favourable conditions for condensation.

The total length of horizontal condenser used in this case was 336 feet, giving a cooling surface of 1311 square feet. In the first 41 feet, presenting a cooling surface of 150 square feet, the temperature was brought down 6·8° Fahr., that is, 1° to 24 square feet of surface; in the next 165 feet, having a cooling surface of 605 square feet, the temperature was reduced 16·4° Fahr., or 1° to 37 square feet; and in the next length of 130 feet, with a cooling surface of 556 square feet, there was a reduction of 16·6° Fahr., or 1° to 34 square feet. The total power of the horizontal condenser being equal to a reduction of 39·8° Fahr., bringing the temperature at the inlet of the vertical or slow-speed condenser down to 103·4°. The cooling surface of the latter, including a short piece of 14-inch pipe, was 1230 square feet. On the outlet of this the temperature was 71·6°, giving a reduction of 1° to every 38 square feet.

The total cooling surface of the condensing apparatus was, as I have already stated, 2541 square feet; and the total effective power equal to a reduction of 71·6° Fahr., or 1° to 35½ feet of surface. The average hourly make of gas was 17,816 cubic feet, giving a condensing surface of 142 square feet per 1000 cubic feet per hour.

As to the consumption of water, which you perceive is very large, namely, 1·918 gallons per 1000 cubic feet of gas exhausted, against a resistance of 12·35 inches head of water, I have simply to say that the matter was very carefully gone into, both in this and in other experiments to which I shall hereafter allude, and I have no doubt as to the correctness of my figures. The method adopted for ascertaining the quantity used was simple. A tank of sufficient capacity was filled with a supply of water to last during the whole experiment, and the consumption calculated from the difference in depth from day to day, due allowance being made for any variation in the level of the water in the boiler. The steam-pipe was 3 inches in diameter, and 53 feet long. It was protected with a wooden trough filled with sand, and all under cover of the same roof as the boiler and exhauster, so that very little, if any, condensation of steam would occur. Both the steam and gas pressure were recorded every 30 minutes during the 120 hours the experiment lasted, and of which the figures I have read are the mean. It is interesting to note the wonderful regularity of the temperature of the gas and steam together at the immediate outlet of the exhauster. Of course, the greater the back pressure the more power—that is, steam—is required to overcome it, and consequently the highest temperature is coincident with the heaviest back pressure, other things being equal. The lowest temperature recorded is 142°, with a daily make of gas of 458,000 cubic feet, and a back pressure of 11¾ inches; and the highest, 144°, with a daily make of 410,000 cubic feet, and a back pressure of 12 inches.

As I have already said, the condensing arrangements alluded to in this experiment were found to be insufficient to cool the gas in mid-winter. After it was concluded, therefore, I fixed between the outlet of the exhauster and No. 2 thermometer, where the temperature in the previous experiment averaged 143°, a light rectangular wrought-iron vessel, 13¼ feet long by 6½ feet wide, by 13½ feet high, having 11 wrought-iron tubes, 9 inches in diameter, running through from top to bottom, which it was previously intended to use as a resting chamber for the deposit of tar and liquor in the primary condensing process before the exhauster. I append a table compiled from the results obtained from three days work with this vessel in use, from which it will be seen that the temperature at the condensed steam-syphon was reduced to 92°, and at the inlet to the washer to 55°, being respectively 28° and 16·6° lower than in the previous experiment without it. The cooling surface in this case was 3596 square feet, being equal to 190 feet per 1000 cubic feet of hourly make, the condensing power being equal to a reduction of 81°, or 1° to every 44½ feet of surface.

—	Gas Made.	Back Pressure of Gas.	Exhaust.	Total Resistance to Exhaust.	Total Water Used in Gallons.	Water Used to Exhaust 1000 Cubic Feet of Gas.	Steam Pressure.	Temperature (Degrees Fahr.). Gas Entering Exhaust.	No. 1. Outlet of Exhaust.	No. 2. 41 Feet from Exhaust.	No. 3. 206 Feet from Exhaust.	No. 4. 336 Feet from Exhaust.	No. 5. Vertical Condenser.	No. 6. Inlet of Washer.	Air.
	Cubic Feet.	Inches.	Inch.	Inches.			lbs.								
April 18–19, 1877. . .	434,000	10·7	0·88	11·58	641·2	1·477	52·9	53	136	112	88	68	55	48	42
April 19–20, „ . . .	462,000	11·1	0·97	12·07	939·7	2·034	50·6	56	137	116	96	84	68	60	45
April 20–21, „ . . .	461,000	10·7	0·95	11·65	713·7	1·548	53·2	57	135	117	93	75	66	58	47
	1,357,000	10·83	0·93	11·76	2294·6	1·683	52·2	55	136	115	92	76	63	55	45

You will see, on comparing this table with the former one, that there was a considerable diminution of temperature at the outlet of the exhauster. The gas and steam pressures being about the same in both cases, it might have been expected that the temperatures at this point would have been similar also, whereas there is a decrease of over 7° in the latter experiment. Probably the explanation of this is to be found partly in the fact that the temperature of the gas at the inlet is lower by 6°, and partly from the consumption of steam being less by about one-quarter of a gallon per 1000 cubic feet. I am not prepared to say positively what gave rise to the diminished consumption of steam in this case. It is quite possible that the rapid condensation of the steam in the chamber immediately on the outlet of the exhauster is one of the causes; but the lessened resistance from the lighter back pressure, though small, must also be noted. Whether the difference, however, in the consumption of steam in the two experiments is to be entirely ascribed to this latter cause further inquiry must determine.

Before passing to the second part of my paper, I will ask your attention briefly to a third and last experiment, extending over two days. It was made to ascertain the effect of an increased back pressure on the consumption of steam. This showed, as you will see by the table annexed, an immense increase on the previous experiments, and amounted to 2·492 gallons, or say 2½ gallons per 1000 cubic feet.

—	Gas Made.	Back Pressure of Gas.	Exhaust.	Total Resistance to Exhaust.	Total Water Used in Gallons.	Water Used to Exhaust 1000 Cubic Feet of Gas.	Steam Pressure.	Temperatures (Degrees Fahr.). Gas Entering Exhaust.	No. 1. Outlet of Exhaust.	No. 2. 41 Feet from Exhaust.	No. 3. 206 Feet from Exhaust.	No. 4. 336 Feet from Exhaust.	No. 5. Vertical Condenser.	No. 6. Inlet of Washer.	Air.
	Cubic Feet.	Inches.	Inch.	Inches.			lbs.								
April 25–26, 1877. . .	362,000	15·4	0·65	16·05	887·0	2·450	53·7	61	148·0	122·0	100·0	81·0	67	60·0	51
April 26–27, „ . . .	369,000	18·7	0·60	19·30	934·8	2·533	51·5	59	149·0	119·0	93·0	70·0	59	53·0	47
	731,000	17·05	0·62	17·67	1821·8	2·492	52·6	60	148·5	120·5	96·5	75·5	63	56·5	49

Having thus laid before you in as concise a form as possible, my experience of the working of the steam-jet, I propose to offer a few remarks on its adaptability and economy. I have already said that the steam-jet does the work of exhaustion, *per se*, steadily and reliably, and no better evidence of my confidence in it can be given than the fact of my having permanently adopted it. The cooling arrangements bear a close resemblance to those described in the second experiment, but a screw-condenser is substituted for the straight pipes. It may be asked, "Why not use Cleland's steam scrubber and get rid of all these pipes?" The effective work of the steam scrubber (or slow-speed condenser) is not more per unit of surface than that of a horizontal or screw arrangement, or even of a vertical one, where the gas has an ascending motion. I am aware that the aim of the steam scrubber is to convert into an ammoniacal solution the water condensed in it; but it has no special advantage as a condenser. There appear to me to be objections to an apparatus such as this when applied as a condenser in conjunction with the jet exhauster. The difficulty that there may be in regulating the flow of gas equally through all the pipes by reason of their clogging, even partially, by deposits of pitchy matter, such as I have shown you, or by naphthaline salts, both of which may be in a greater or lesser degree considered concomitants of the steam-jet, is a reason which, in my opinion, entirely precludes its adoption. At all events, I prefer an arrangement such as I have mentioned, based on old and well-tried principles. It is free from the dangers attending the steam scrubber, and per unit of surface is quite as effective for the purposes of condensation.

The best method of dealing with the condensed steam is one that must be determined by circumstances. In the case before us, the exhauster was working on the outlet of the washer and scrubbers, in which ammoniacal liquor was copiously used, so there was not much ammonia left in the gas. Consequently, the condensed steam did not contain more on an average than two ounces of ammonia per gallon of water, but even with the large quantity produced, no difficulty was found in raising it along with the ordinary ammoniacal liquor to 6° and 7° Twaddel, with the pumping arrangements formerly in use. If the whole of the ammonia be removed from the gas by the use of clean water before the exhauster, the condensed steam may be most conveniently run to waste or used under the retort furnaces, as it will possess no value whatever. But in cases where large quantities of liquor can be easily disposed of, it would be found advantageous to use it for the purification of the gas in the ordinary washers and scrubbers.

The amount of steam required undoubtedly points to room for improvement in the construction of the exhauster; for it cannot be considered as having even approached perfection, so long as the expenditure of steam is so much larger than is required by engines. From an economical point of view this question presents the strongest argument that can be urged *against* the exhauster, and it is one well worthy the attention of the makers.

I will now take in order the various advantages claimed for the steam-jet, compared with other exhausters. These are nine; but may practically be summed up as consisting in—(1), greater make of gas per ton of coal; (2), increased illuminating power; (3), small cost compared with engines and mechanical exhausters; and (4), reduction of wear and tear and liability to derangement.

First, as to the statement that more gas per ton of coal is obtained by the use of this exhauster than with other forms, I would observe that the mere act of exhausting is not capable of realizing such a result, and if the claim is to be substantiated, it must be on the ground of altered conditions of manufacture, or changes of a chemical nature. The only change of manufacturing conditions due to the exhauster is a reduction of the

dip, and, so far as I can see, the only changes of a chemical nature that can come into operation arise *first* from the more rapid withdrawal of the gas from the retort, in the event of the dip being reduced; and, *second*, from the volatilization of the lighter portions of the tar by the heat imparted by the steam. From a scientific point of view it can hardly be considered a satisfactory test to set one period of working with an ordinary exhauster against another with the steam-jet, and claim for either of them any advantage which may be revealed in the comparison, unless it is clearly ascertained that like material was used, and that similar conditions of temperature in the carbonizing arrangements existed in both cases. To secure such a similarity of conditions is, to say the least of it, difficult, if not impossible in practical working, and in saying that I have not found any special advantages in favour of the steam-jet in regard to yield of gas, I must be understood as speaking by comparison. Steadiness of exhaustion, with the attendant advantages it presents for reducing the pressure in the interior of the retorts, is the special aim of all exhausting appliances in gas-works, and no doubt the belief, that the direct action of the steam is the likeliest method to secure this result is the origin of the claim of a superior production of gas by its use. But where the hydraulic main exists it is impossible to remove all pressure, or to prevent oscillation in the interior of the retorts, and I am not prepared to admit that under such circumstances the steam-jet can be brought to act in a way so much superior to good exhausters of the ordinary type. As I have already said, my experience without the hydraulic main leads to the conclusion that there is no gain in quantity; and to my mind more convincing proof than any that has been produced is required to show that it would be otherwise where the hydraulic main does exist. Compared with old and imperfect machines, the adoption of the steam-jet would undoubtedly present advantages; but the real merits of the machine must be measured only by comparison with the best mechanical exhausters. I simply allude here to the chemical action of the steam upon the tarry particles in the gas, to say that whatever may be the ultimate effect of their decomposition it does not appear to increase the volume of gas, while, on the other hand, I cannot but view the deposit of a pitchy mass such as I have shown you as otherwise than a disadvantage and a loss.

The next claim for the jet is an increase in the illuminating power of the gas. The amount is variously given, and reaches as much as 2 candles. I need not say that if such a thing could be shown to exist, a much stronger case could be made out for the steam-jet. I must confess to have had grave doubts as to the possible effects of the steam on the gas, and it was not until the matter was carefully investigated, in the manner I will presently describe, that my doubts were removed. In determining such a question as this, it is manifestly useless to make any comparison of the illuminating power during one period with another. Experience teaches that variations occur, even when apparently precisely similar conditions exist. It is only by submitting the same gas before and after exhaustion to comparative examination that the question can be satisfactorily settled. The gas on the inlet side of the exhauster, being in a state of partial vacuum, cannot be consumed by its own pressure, and mechanical means must be resorted to, to draw off samples for testing. The first method that occurred to me was to fill a small gasholder of 3 feet capacity, by means of counter-weights, testing the sample so obtained by means of Sugg's jet photometer, alternately with the gas on the outlet after being cooled. The results obtained by this means were very conflicting. I next endeavoured to obtain a supply by means of an ordinary wet meter, making the outlet of the meter the inlet for the gas, and turning the drum of the meter firstly by a weight working over a pulley on the drum-shaft, and, secondly, by hand. Both of these methods gave a supply of such a variable pressure that I had to resort to other means, and ultimately adopted the arrangement shown in the diagram, designed by my assistant, Mr. Coombs, in which the pressure of the outlet gas is utilized to give a sufficient pressure to the inlet gas to enable it to be consumed at the jet photometer. The apparatus consisted of a rectangular chamber, formed of sheet tin, and divided into two compartments by a partition in the middle descending to within 2 or 3 inches of the bottom. The chamber was half filled with water and the two compartments so formed connected with the two supplies of gas respectively. The outlet of each was connected with a pipe that supplied a few burners, and from which the supply to the jet photometer was also taken. The gas from both sources was, of course, purified by passing through lime before entering the water-chamber as shown.

The action of the water-chamber is as follows:—After blowing out the apparatus with the outlet gas, which in the present case had a pressure of from 12 to 16 inches, the supply of inlet gas and the delivery of outlet gas is shut off. The supply of outlet gas being continued, the water in this part of the chamber will be lowered, and that in the other part of the chamber raised by the accumulating pressure, thus expelling the gas on the inlet side to be consumed and tested. As the difference of level of water in the two compartments approaches that due to the pressure of the outlet gas (which is seen by the gradual lowering of the lights) the discharge of outlet gas from the chamber is substituted for the inlet gas by simultaneously opening the one cock and closing the other; and immediately afterwards the supply of outlet gas to the chamber is discontinued, and the inlet gas admitted by a similar operation. The outlet gas which has filled one portion of the chamber by its own pressure is now driven out by the head of water thus formed in the other compartment, and at the same time another sample of inlet gas is drawn in to be afterwards consumed and tested as before. The result of this experiment is to show an increase of illuminating power in the outlet gas corresponding to about 2-100ths on the gauge of the photometer; that is, about three-quarters of a candle in gas and from 15 to 16 candles.

The question arises, to what is this increase due? I think there is but one explanation. I have already mentioned the obtaining of a thick pitchy deposit in the condenser, and this fact, taken in conjunction with the increase of illuminating power, may be readily traced to the chemical action of the steam upon the tarry particles in the unpurified gas, which vaporizes their more volatile constituents, and converts them into a gas of a more or less permanent character. From the fact that no increase in the yield per ton has been obtained, together with the occurrence of naphthaline deposits in the washers and elsewhere on the works, I am inclined to think they are not permanent.

You are aware that it has been the custom of late years to condense the gas as much as possible in presence of the tar and liquor in horizontal condensers. One of the chief objects of the arrangement is to allow the tar to absorb those hydrocarbons which otherwise would be carried forward in the gas, and, under sudden variation of temperature, be deposited in the pipes in the form of a salt. I am not prepared yet to accept the theories of those, with whose opinions generally I have great sympathy, who consider it is possible to retain in the gas all the light-giving properties usually absorbed by the tar. I rather view the effect of the steam-jet in this respect as a disadvantage. The true office of the exhauster is to perform a mechanical operation, and the more strictly it is confined to it the better.

On the questions of cost and wear and tear, I do not propose to dwell, having already occupied too much time. They are matters which are obviously in favour of the steam-jet, and such as can easily be determined by engineers for themselves.

The PRESIDENT: We have been listening to a very able paper—a paper which furnishes evidence that we have all of us something to learn. Our occupation has not gone; that is something refreshing. I have no doubt that the interesting matters which have just been brought before us will lead to further experiment and research.

Mr. MORTON (ex-President) said he had had some little trial of this jet exhauster, and having listened very carefully to Mr. Paterson's paper, he must confess to a feeling of considerable surprise at some of the statements made with regard to the apparatus, more especially with reference to the consumption of steam. Mr. Paterson stated that, having 12 inches of back pressure, he used nearly two gallons of water per 1000 cubic feet of gas exhausted, with a steam pressure of 52 lbs. He (Mr. Morton) had between 90 lbs. and 100 lbs. steam pressure, and, of course, there was less water evaporated to do the same duty, and less latent heat to be extracted. But working against something like 28 inches back pressure, or taking the total exhaust and pressure at 30 inches, he did not require to evaporate more than 1½ gallon of water per 1000 cubic feet. And this, he thought, pointed, in Mr. Paterson's case, to some defect in the exhauster itself, or in the arrangement of the ports of the exhauster, with regard to the quantity of gas that was being passed. He (Mr. Morton) found that by increasing or decreasing the area of the ports admitting the gas through the exhauster, he could use less or more water at pleasure. Of course, the object was to use as little water as possible, and with something like a 20-inch pressure at a vacuum, very little over one gallon of water was used when the ports were properly adjusted. He was, therefore, extremely surprised to hear Mr. Paterson state that he required to use two gallons at something like half the pressure. There must have been something radically wrong in the exhauster itself. Mr. Paterson had not stated how he measured the water. He (Mr. Morton) might say that he measured the water as put into the boiler, there being a separate boiler for the exhauster, so that he could determine the quantity exactly. Then the fact of Mr. Paterson having his exhauster placed on the outlet of all his previous apparatus, except the purifiers—his condensers, scrubbers, and washers—and having a deposit of pitch, due, no doubt, to the action of the steam on the tarry particles, pointed, he thought, to the apparatus being in a very defective condition. He did not think that Mr. Paterson or any other engineer present should leave tarry particles in the gas to that extent, after thorough condensation and scrubbing. His (Mr. Morton's) jet exhauster was placed at the outlet of the ordinary condenser, and the gas containing the bulk of its ammonia was passed through a Cleland steam-scrubber. The ammonia taken out by that scrubber gave a liquor of from 8 oz. to 10 oz. strength; but the difficulty he had to contend with when the distribution through the steam scrubber was as perfect as he could make it, was that when the temperature of the outlet gas was brought down to something like 60° or 70°, there were about 50 grains of ammonia per 100 cubic feet left in the gas. Mr. Cleland claimed for his steam exhauster that it practically took out the whole of the ammonia, and he stated that he used nothing else in Liverpool than this for taking out the ammonia; but he (Mr. Morton) found that, under the most favourable circumstances, something like 50 grains per 100 feet was still left in the gas.

Mr. BRETT (Hertford) said he had used a Körting-Cleland exhauster for about seven months. It was attached to the outlet of the hydraulic main, or rather to the main that was carried over the beds of retorts from the outlet of the hydraulic main. On first using it he found that he could not get his gas at the entrance of the meter below 76° or 80°; but on increasing the condensing power by the employment of a new horizontal condenser of about 200 feet of 10-inch main, he succeeded in getting his gas on an average in the winter down to 57°. He had also experienced the difficulty referred to by Mr. Morton, through not properly arranging the ports of the exhauster. Since the employment of the exhauster he had only been troubled with naphthaline once, whereas in the previous winter he had found it three or four times a week. Formerly, too, he had been troubled with tarry matter in the purifier; now he was quite free from it. With reference to the remark made as to the equalization of the gauge, he could vouch for its steadiness, for though close to the hydraulic main, the oscillation was scarcely perceptible. As regarded the illuminating power of the gas, he found that using the same description of coal employed the previous winter, there was an increase of about one candle, and the make of gas was certainly not less, but perhaps a little more.

Mr. WEST (Maidstone) would like to know whether the writer of the paper had tried the apparatus at a low pressure—say between 30 lbs. and 40 lbs. in the boiler—for it appeared to him to be entirely a question of high or low pressure. The higher the pressure the more economically they could work in all boilers.

Mr. BRETT said he worked at 25 lbs. pressure, but then he had a back pressure of 6 inches.

Mr. GODDARD (Ipswich) said he had had experience of the Körting exhauster during the last eight months working, and found it maintained a very even gauge. He had it placed after the horizontal condenser, and he had experienced the same inconvenience mentioned by Mr. Paterson with regard to the thick tarry matter. He passed the gas, after going through the steam exhauster, through a vertical condenser, and the liquor he got from it was about 10° Twaddel. He was able to get much stronger liquor from the hydraulic since he had adopted the horizontal condenser, and had not been at all troubled with naphthaline since he had had the jet exhauster in operation. He worked at about 50 lbs. pressure.

Mr. CRANMER (Stratford-on-Avon) remarked that in small gas-works they were not always able to get a man capable of looking after the pressure of the steam, and it might vary from 70 lbs. to 30 lbs. He would like to know what difference that would make to the use of the exhauster.

Mr. PATERSON, in reply to the observations made upon his paper, said he thought he had clearly explained that he gauged the water he used in his experiments by the difference of level in the tank, which he reserved exclusively for the purpose of the trials he was making. There was no particle of water drawn out of the tank, but what was going to the steam-jet. He thought Mr. Morton's remarks with reference to the ports of the exhauster were perfectly relevant, and he entirely agreed with him. It was to the construction of the jet that he wished to draw attention, because he could not consider it by any means at present as a perfect machine, requiring, as it did, so large an expenditure of steam to do its work. In fact, as he said in his paper, it could not be regarded as approaching perfection so long as the expenditure of steam was so much larger than was required by engines. He did not feel himself qualified, however, to say what alteration was necessary in the exhauster so as to make it more effective in its work; still he thought there was room for improvement. In his opinion, a longer induction-tube would conduce to more effective and economical work. After the experiments, the results of which he had stated, he purposely laid off the exhauster in order to ascertain whether the nozzle inside the exhauster was in perfect order, because one could understand that if that was choked or broken, or in an imperfect state, the steam would lose the action conducive to induction. He found, however, that it was perfectly in order. He

was not prepared to say that his condensing arrangements were as perfect as he should like to have them—he referred to the condensing arrangements before the exhauster; at the same time, he could not regard them as imperfect; indeed, he thought he had shown in his paper sufficient evidence as to the effective work his primary condenser was doing, because the highest temperature of the inlet gas in April, when the atmosphere was 56°, was 63°, and it had passed through a washer and scrubber, as well as a condenser, before it reached that point. The washer was a large resting chamber—a douche scrubber—consisting of a rectangular vessel with horizontal trays, over which a large volume of water was pumped, and passed though the holes up which the gas rose. There were only three trays in this vessel, which was something like 15 or 16 feet high, so that everything was conducive to the deposit of the tarry matters. He was not prepared to admit that any form of condenser would entirely remove the tarry particles that were held in suspension in the gas, which were so minute that it was with the greatest difficulty they could be kept down. The dip washer and the bell washer were the best appliances he knew of for the purpose, but they could not be used before the exhauster. Then in the steam-jet exhauster there was this difficulty to be dealt with, that the heat of the steam converted these light tarry particles into, first of all, gas of high illuminating power, and then depositing pitchy matter. This gas not being capable of being held in suspension, became deposited in the pipes in the form of naphthaline salts. He could not shake from his mind the conviction that these were concomitants of the steam-jet which no appliance before the exhauster would get rid of. Mr. Brett said he had fixed his jet on the hydraulic main. He (Mr. Paterson) believed there was ground for thinking that to fix the exhauster in that position must lead to mischief. The temperature of the gas in the hydraulic main was not less than 120°, and to run high-pressure steam into that would be to increase the temperature considerably, the consequence of which he could not imagine. He was not in a position to say where, but he knew that placing the exhauster on the hydraulic main had been tried elsewhere, and the result was that the condenser, which was a vertical one of the annular type, became completely choked with a deposit of naphthaline salts mixed with pitchy matters. In answer to Mr. West he must state that he had no record of the variations of the pressure of steam; he had not gone into that. He had varied the back pressure, and found there was an increased consumption with an increased back pressure, and he could not help coming to the conclusion that with a diminished pressure of steam there would be an increased consumption of water equivalent to the increased back pressure. He was rather surprised to find that Mr. Goddard, while getting pitch, did not get naphthaline. Seeing that he himself did get it, he was disposed to think that Mr. Goddard's condensing arrangements after the exhauster were more perfect than his own, for it was quite clear that if the gas were condensed in any way so as to retain in it those light-giving qualities which in some conditions became naphthaline salts, that must be the best form of condenser that could be adopted. But he could not imagine that Mr. Goddard would be ablo to go on very long in that way. He had only had a few months trial with the apparatus, and, with all deference to the opinion of that gentleman, he could only anticipate that he would have difficulties in this direction in the future. Mr. Cranmer's question as to the variation in the pressure of the steam was hardly a question growing out of the paper.

The PRESIDENT said he had listened with much interest to the reading of the paper and the discussion, having been led to put some faith in this exhauster. Indeed, so highly had he thought of it, that in recently designing new works, capable of manufacturing half a million feet of gas per day, he had intended to rely entirely upon the Körting exhauster, and to give it a fair trial. His opinions were somewhat opposed to those which had been expressed as to the practical working of the apparatus, and he would tell the meeting in what respect. He had yet to satisfy himself, for instance, as to whether the gas should be taken at or near the hydraulic main, or after the condenser, or after the scrubber. His notion was to take the gas from the ends of a pipe or pipes running round the retort-house (the retort-house being 200 feet long), the exhauster being placed before the condenser, and then send the gas forward. It seemed to him to be doing the work twice over to cool the gas down, and then to warm it up again, which would be the operation if the exhauster was placed after the condenser. He was not at present frightened at the apparent danger of treating it in this way. He was inclined to think the tar would be poorer by the process, but then one could not eat his pudding and have it too. The first object of the manager should not be to make rich tar, but good gas. From all he had seen of the apparatus, he was inclined to think that Körting's exhauster would be in favour with gas managers by-and-by; and as to the discrepancies alluded to by the writer, he was not at all surprised. It was a new machine, and might require some careful observation and experience before the best mode of handling it was determined on. Therefore he would say to every member of the Association, "Try it as you have opportunity. Separate some portion of your retort-house for the purpose, and try it in various ways, bearing in mind the vulnerable points, and seeking to remedy those disadvantages which have this morning been indicated in the experience of Mr. Paterson, and the better experience, in some respects, of Mr. Morton." Mr. Morton was satisfied with one gallon of water; Mr. Paterson was more thirsty, and required two gallons. These things could only be settled by practical experience; meantime, he was sure the Association would accord thanks to Mr. Paterson for the pains he had bestowed on the preparation of the paper just read.

Mr. R. W. BRETT (Hertford) read the following paper on

THE SUPPLY OF GAS TO PUBLIC LAMPS.

In bringing this paper before your notice, I feel I have undertaken a task to which I am unable of myself to give full justice; but I trust it will be the means of promoting a discussion or inquiry, in which we shall have the opinions of some of our more experienced members, thereby making it more authoritative, and paving the way to more profitable results.

There can be no disputing the fact that the system itself is not carried out with any universal arrangement; but the means adopted form a labyrinth of ideas in some cases almost difficult to conceive. We have had a number of papers on subjects from the retort-house to the burner, defining the causes of the loss of gas; but I am led to think that a very considerable amount of it passes off through that troublesome consumer, the public lamp.

I have to thank a number of brother members for their replies to my queries some time ago, and it is upon these replies I have to rely for no small amount of the information I shall produce. Some of them were supplemented with accounts of frequent troubles with the local authorities; and I deem myself (as questions were only asked of members of our Association) in duty bound to give an account of them, to the best of my ability, without stating name of town or authority. I have not included gas undertakings owned by local authorities under any heads but those of governors and meters.

The main points, then, are the services and stand-pipes, meters, taps, governors, and burners, the fixing and repairing the same, and the conditions on which the gas is supplied to the local authority; and as any one of these is worthy of a paper, I am compelled to condense each of them.

Firstly, then, as to the services, no one can dispute the advisability of these being the property of those supplying the gas. But that this rule is not universal is proved in the fact that, in no less than 88 instances out of 243 they belong to the local authorities, and among the remaining 155 the gas company only claim to the foot of stand-pipe in many cases, the local authority repairing all above ground. The supplying, fixing, and repairing in a number of instances is done by painters, plumbers, gunsmiths, blacksmiths, and, in fact, most inexperienced men are employed by both gas companies and local authorities to perform this most important work. It matters not to such whether gas escapes or not; all they care is that the pipe is put out of sight, and that gas passes through to the burner, they know their bill is safe. The employment of such labour as this cannot be too fully deprecated. Those supplying the gas should insist (as a condition of supply) on fixing and repairing the service, even if it is to become the property of the local authority, but on no account should they be allowed to interfere in any way, though they are very apt to assert that they can do as they like with their own property.

It is very essential that none but skilled labour should be employed, and that it should be the labour of those supplying the gas, inasmuch as there is naturally more interest taken by them than by outsiders. The tools and the fittings, too, should be the best, for a badly-tapped main, or a badly-threaded pipe, would prove the source of as much escape as a badly-welded tube. To secure all this, the authority supplying the gas must have the entire control of all the service. To ensure a good supply, the service to a lamp should not be less than three-quarters of an inch, attached to the main by a connecting piece, and a back-nut and gummet screwed tight up to the main, and having a tee-piece and plug at the bottom of the stand-pipe.

A number of suggestions have been made and plans adopted for the preservation of services, especially for the hungry, damp, gravelly soil. Some propose that the pipe should be encased in a box or trough, filled with sawdust and tar; others pitch, tar, and paint; whilst some put the plain pipe into the ground, without making any provision for its preservation. Now, the troughs, though very effective, are rather too costly for small undertakings, and as for bare painting or tarring, it does not answer. The method I adopt is to have all wrought-iron pipe, when new, covered with a coat of good paint, and, when laying it into the ground, mix some tar with the earth, making, as it were, a tar concrete round the pipe. I think this will prove effective, but I almost question whether some tars alone preserve the pipes at all. I have found some very much eaten into when only tar has been used; but, let whatever methods be adopted for their preservation, they are futile when rust has once commenced its work, hence the necessity of well painting the tubes when new.

The stand-pipe from the service to the tap should not be less than half an inch, and inside the column, as also against the walls, should be wrought iron; any metal used in the brackets must not be less than three-eighths of an inch in the bore; copper or brass should not be used; in fact, iron throughout is the best. Care must be taken that the internal pipes of a lamp-column are firmly fixed, and I should recommend that at the annual, or other examination the pipes should be taken out and painted, as some of them will be found more rusted than if exposed to the open air. The stand-pipes against walls should also be well painted. The usual plan is to just bedaub the part seen, which is really that least needing it, as the dirt, cobwebs, &c., encourage the moisture between the pipe and the wall, and excessive corrosion is the result. As the painting is generally done by contract, these in no way mean points are entirely overlooked. To prevent escape when examining the stand-pipe of a column, a small india-rubber plunger attached to a ¼-inch rod may be used; it will also answer for a guide for refixing the pipe in its position, into which it may be lowered as painted.

The next things we have to consider are the meters. Some suggest that the average meter system should be adopted, others not; and to prove that this is a question far from settled, I may say that in 296 instances only 80 use meters—viz., 59 gas companies and 21 local authorities, leaving 179 gas companies and 37 local authorities not using them. Where they are used by the companies they are charged at a rental. As to the average number, it varies; for instance, in two cases a meter is fixed to every lamp, and as a set-off to that, one or two use it at the rate of one to every 100 lamps. But leaving out these exceptions, the average is one in 14. If the district is uneven, and no district or lamp governor used, I should say, have a meter to every lamp; but if the conditions are the reverse, the less meters the better. But with all this, some are contemplating using, and others discontinuing the use of, meters to the lamps.

Now, surely one system must be right, and there cannot be anything wrong in the meter system, under proper conditions. The authorities generally prefer them; at the same time they are the source of a great number of unpleasantnesses and warm disputes. The inspectors of the local authorities often being men ignorant of anything practically appertaining to gas, rush into figures attempting to prove that the company are doing everything to rob the public; and, should it be the lot of the company to light and extinguish, of course they are accused of leaving on metered lamps, or leaving out non-metered ones. If the local authority light, *this* would not be done; these are the chief difficulties to the more general adoption of the system. The conditions, I think you will agree with me, for more effectively carrying it out, are—first, that the meter must show as little as possible the result of friction, not taking more than 1-10th pressure to work it—less, if it can be; the position of the meter must also be taken into account. In a number of towns it is in the base of the column, in some underground, and I have seen some fixed in boxes on the flats of walls. The underground plan is by far the best, from its non-liability to be affected by changes of temperature, which alter considerably the registration. In the event of its being in the base of the column, the lowness of the temperature, especially when the consumption is at its highest—viz., in winter—must be the cause of a great amount of unaccounted-for gas. As to fixing the meters in boxes against walls, I should not at all recommend it for any reason.

Not only must the meter be the more perfect for the average meter system, but the tap, the governor, and the burner must be so also. The full way of the tap the Gas Referees put at one quarter inch, and the minimum pressure at the inlet of the governor at 5-10ths, and at the point of consumption 2-10ths. Most crank-taps in use are apt to get loose at the screw and collar, which tighten the plug into its place, and a liability to loss is apparent, there being sometimes rough usage to them when working stiff, from the torch, and often when the repairs are not under the supervision of the gas company, these leaks go on for some time unnoticed, or, if noticed, not reported. In some cases the screw is loosened by the knife of a lamplighter, and sometimes it is lost altogether. This evil is, in a great measure, met by a crank-tap; I am using one supplied by Mr. Sugg, the plug of which is held in position by a screw passing through the body of the tap into a groove in the plug; I think practice will prove that this is a step in the right course. I am now alluding to lighting by torch, although we have still the ladder in use where the torch would be advantageous.

Next in order follows by far the most important appliance—I allude to the lamp governors—and here alone, from their most importance, is room for a future lengthy practical paper and discussion, for great improvements have been made in them these last few years. I hold them to be essential, and the only safe appliance to lead to the goal of perfection and fairness between the gas company and the local authority as to the gas supply, and if anything will aid the use of meters to street-lamps, it will be the general adoption of a reliable lamp governor. I think with such instruments any zealot of the hourly rate system would give in at once. There are a great number of governors in the market, some of them excellent specimens. But I must recommend every one, before he generally adopts them, to make himself thoroughly acquainted with them. I am aware that in some instances the directors will not sanction a slight outlay for testing apparatus, but we must class these among the "penny wise and pound foolish" clique of ignoramuses. For instance, governors are ordered to pass, say, 5 feet per hour of 14-candle gas at a minimum pressure of 5-10ths. The governors come to hand, are tested for consumption at the above and augmented pressure, and they are apparently as required; but accidents will happen, therefore suppose a burner gets broken in springing, or by some other unlooked-for means, the result is that a number of these governors will pass 10 or 12 feet per hour. Now, in such cases as these, it appears they are dependent on the burners to help them, and very often the burners sent with them are not adapted to the gas; for one suited to 30-candle gas at 5 feet per hour would not give the light of a farthing dip of 14-candle gas at the same rate of consumption; hence arises one of the difficulties to the more universal adoption of the lamp governor, which, if a perfect one, should not pass more than its specified quantity, even without a burner. Then the person using the governor can make his selection of the burner best suiting his gas, taking care that it is sufficiently large to pass its full quantity at minimum pressure. Then if, with the governor and suitable burner, say 5 feet per hour can be passed at 5-10ths pressure, and this consumption cannot be increased with augmented pressure, nor can it with the burner out, we have all we require. I have taken 5 feet consumption merely as an example; of course these would vary according to requirements. The 5-10ths pressure would be as low (bar accidents) as one would expect to find even at metered lamps, but I think it essential to have at least 3-10ths margin above the 5, to ensure against little mishaps, &c. It is rather singular that out of 296 authorities supplying gas, there are still 91 using the burner without governors, 15 of these with meters, and 76 without. Some of the burners, very good in their way—such as the Brönner, Bray, Clegg, German, and others—ensure a good combustion, but do not govern. Not only are these burners used, but there is likewise a strange admixture of common bat's-wing and fishtail, supposed to consume in quantities from 2 to 5 feet per hour. There is the single jet in Scotland, and there and elsewhere we find union jets—No. 1 calculated to 1 and 2 feet per hour, No. 2 to 4 feet, and No. 3 to 6 feet, supposed to be passing, some one amount and some another, up to 5 and 6 feet per hour. Now, in such instances as these, how are they regulated? Will any of them pass the same at 5-10ths as at 15-10ths pressure? The following table proves to the contrary by giving the increase in consumption in 10ths of an inch.

No. of Burner.	Brönner.	Bray.	Clegg.	Leoni.	Jet.	Bat.
3 ..	1·5 ..	2·0 ..	— ..	3·3 ..	2·4 ..	—
4 ..	1·65 ..	2·5 ..	— ..	4·0 ..	2·9 ..	2·0
5 ..	2·9 ..	3·2 ..	4·3 ..	4·2 ..	3·5 ..	3·7
6 ..	3·5 ..	3·6 ..	4·4 ..	4·4 ..	4·4 ..	4·8

With such burners as these, how are the charges regulated? They are all charged at some stated rate, and it cannot be disputed that, in some hilly districts, where the district governor is not used, there must be an alarming difference, and also an alarming loss, whether meters are used or not. As an example of the use of one of the better class of burners without a governor, but under the average meter system, showing clearly a loss by using a meter to other than governed burners, I may mention that I once tested and found that at the metered lamp-columns there were only 2·75 feet per hour passing, at the columns not metered 3·57 cubic feet, and at the brackets 3·31 cubic feet per hour; or, putting it in plain figures, the company were losing 0·82 cubic feet per hour, or 12s. 6d. per year, on lamp-columns, and 0·56 per hour, or about 8s. per year, on all the lamp-brackets—this, too, with a No. 3½ burner. Now, if so heavy a loss with so small a burner, what must it be where the burners are large, and, perhaps, 2-10ths or 3-10ths taken off by the meter, making, for every tenth, a difference of about 0·25 feet per hour, which, if going on for 4000 hours, gives 1000 cubic feet per lamp per year—no mean item where several hundreds of lamps are used. But this is taking it very low. Where the governor is not used, we are told the light is regulated by sight. I should like to know whose eye is sufficiently practised to tell the quantity of gas passing through a common bat's-wing, some of which will give a far better light at 5 feet per hour than others will at 10 feet? In such cases the loss must be beyond conception, and hundreds of pounds are lost by the gas companies, the public reaping the benefit. Now, by the use of the governor, all these differences of district, meter, &c., are put out of question. But, as I before stated, there is scope for a separate paper here, still I hope I have said enough to show that the governor is really a necessity in street lighting. As to the use of a meter or no meter where the governor is used, it is immaterial (although I should prefer it), but it is positively essential at every lamp where it is not used.

As to the modes of lighting, I have not much to say, but will leave that to others more conversant with the tried and untried appliances. I think that the present almost universal means of lighting by torch will be some time before it is superseded. But who can tell what may be in store? We hear so much of the lime, magnesium, and electric lights—these are days of wonderful advances in science, and none of us can foresee what may be in the future; and it is well we cannot, for we might be almost ready to forsake our trust, and search in other fields of industry.

I have had an automatic lamplighter brought to my notice, and I must confess it is a most beautiful instrument. It is a governor as well as a lamplighter. On turning on the light, the pressure is conveyed from a small jet (where it is kept alight all day) to the burner, which takes up the increased supply of gas. Upon this lighting, the jet goes out, the light at the burner continuing the same at the decreasing pressure of the night. To extinguish the lights the pressure has to be increased, and on again taking it off, the apparatus is so arranged that the holder drops, opening the gas-way to the jet and closing it to the burner. I have one here for your inspection; but as I believe there are gentlemen here who have used it, perhaps we may hear more of it.

I should certainly recommend gas companies to light and extinguish the lamps themselves. There are many advantages, they being more readily made acquainted with anything in the shape of leaks, want of pressure, accidents, &c. Out of 237 companies, 163 do this work; but some of it is undertaken by contractors in their employ, these also do repairs.

As to the matter of lamp-posts and brackets, I think we may leave them, for it is almost impossible to set any rule for guidance. The local authorities generally direct them to be set up here and there, very often regardless of the position at which the light is required, and we are in many cases bound by their decisions. Some say they should be 70 or 80 yards apart; but this is not to be used as data. Lamps with a fair light and fair way to shine should not be more than 70 or 80 yards apart; but we find in the densely-populated City of London, 20 yards often nearer the mark. There is no question that towns well lighted are not so well robbed, for the public lamp is a public guardian always found at his post, when properly fed.

It is well on the part of those supplying gas to see that the lanterns are so constructed that the full benefit of light is obtained; for, in many instances, we see about an inch or two of paint, putty, and metal at each of the angles of a lantern, and as much shade as light thrown round. Then there is the very awkward cradle, casting positive shades in all directions. There are some excellent specimens of lanterns in existence—viz., the Catoptric, the Westminster, &c.; but I think these are more for local boards and private consumers in small towns than for gas companies to look to. I know where the introduction of the Catoptric led to the leaving out several of the town lamps; and we provincial folks find the public authorities take every opportunity of leaving lamps out. Mr. Keen, of Hastings, too, has a neat double-clipped lamp, which does away with the putty; the glass, too, can be removed whilst painting. But there is the objection in most lamps that they cast too much shade. I have a specimen of one here that I think meets the requirements. There is but one shade cast outwards from it, and that may be kept the wall side. Both the top and bottom frame clip on to the support, which can be used to pillar or bracket. The glass is fixed in by clips. The top may be glazed or not it can be easily taken to pieces, and can be packed in a very small compass.

It does not affect a gas company, whether or not they own the lamp-columns, &c.; if they own them they charge for their use. The conditions of supply seem to be the most varying. Some gas companies merely supply the gas; some supply gas and repairs, but do not light; others supply and light, but do not do repairs; and others neither light nor repair, whilst some do all. But I must say again that whether the fittings, &c., belong to, or the lighting is done by, the local authority, the gas companies must, under no circumstances, allow the local authority to either fix or repair any fittings through which passes unregistered gas, and this should be clearly laid down in an agreement, with other matters, which should always exist where gas companies supply local authorities.

The very generally adopted plan is to charge the number of hours consumption at per hour, by a table of lighting, the gas company doing the lighting and repairs. Then there is the yearly rate from sunset to sunrise, the average charges being in the north about £3, in the south £3 15s., in the west £3 5s., and in the east, including the London district, £4 15s. The highest under this head appears to be £5 5s.

The average charge for repairing, painting, and lighting is about 15s. 3d. per lamp. I do not consider this sufficient; 16s. or 17s. is little enough. one or two generous companies do the work for 10s., whilst another charge 23s. Among the charges we find 2d. per lamp per night for gas and lighting, 3s. 6d. for maintenance only, 1s. per lamp per week without repairs, 2d. per lamp per week for lighting only, and 8s. 6d. per lamp per year; 10s. per lamp per year, which is not bad, and we should do well if we could all get it. But all this must be affected in a measure by locality. Still the charge is pretty general. There are a few more eccentricities. We have some towns in which (though there are gas-works) the streets are lighted with oil; in another the gas is supplied at cost price, having a loan of money from the town free of interest, and it is given in two cases; ½d. per hour per lamp is another charge. Some put out part and others all their lamps at times varying from nine p.m. till sunrise; some leave out a week before and after full moon; some light three, four, five, and six months only; nine months is a very common time, and there are other mixtures too varying to bring to your notice.

I am sorry that I have encroached on so much time with this paper, but there is in any one of the subjects ample scope for an independent and lengthy discussion. I may add that in drawing up agreements of supply, the chief points that must on all accounts be inserted are, that the authority furnishing the gas should insist on supplying, and fixing, and repairing the services and fittings and on the use of governers, and if the local authority light and the gas is charged per hour instead of meter, the torches should be kept at the gas, police, or fire stations, and notes made of the time they are taken out and returned. I now place the facts in your hands, hoping that, by the aid of my more experienced seniors, general good may accrue therefrom.

Mr. A. F. Wilson (London) thought it would be very interesting if they could get at the bottom of the question as to the expense of laying a separate system of mains for the supply of the public lamps. If it could be done the lamp consumption would then be determined by a station or large meter at the outlet, and the disputes as to the variations of consumption now continually arising would be settled for ever. Most of the members present remembered the transitions which had taken place in the modes of supply, from the system of contracts at so much per lamp per annum, double taps, governors, average meters, &c.; and referring to the meter system, he might remark that it seemed to him, if they had to put a meter to every lamp, they might as well go to the expense of laying a separate main for the special supply of the public.

Mr. J. Johnson (London) said for a great many years he had been much troubled with this question of the supply of gas to public lamps, and he had come to the conclusion, after trying almost every scheme, that the only way to get along comfortably was to adopt the average meter system. He knew, from a great many experiments made during the past year, that gas companies had been serious losers by the ordinary contract system of lighting. Year after year he had taken down hundreds, and in some years thousands, of governors and burners for the purpose of testing them; and, after getting the best governors and burners that were made, he found great variations in the quantity of gas consumed by them. About four years ago, in the City of London, a bold statement was made by the chairman of the Gas Committee of the Corporation—that although the gas company were receiving payment for 5 feet of gas per lamp per hour, the consumption was only 3½ feet. He (Mr. Johnson) thereupon suggested that they should appoint some independent person to test the governors, to ascertain what the actual consumption was. The Gas Committee accordingly appointed Mr. Heisch for the purpose, and the matter was left entirely in that gentleman's hands to select which of them he would experiment upon. In the result it was found that, instead of consuming only 3½ feet per hour, as was stated by the chairman of the Gas Committee, they averaged 5·7 feet per hour. At one time he was always having complaints made as to the irregular way in which the lamps were lighted in those parishes in which the average meter system was adopted, but now all such complaints had ceased, and those who formerly had the charge of doing this work had their minds entirely at rest on the subject, for they could answer any expressions of dissatisfaction by saying, "The matter is in your own hands; the gas company are not responsible; and if you have anything to complain of, you must go to the local authorities;" a very desirable state of things for a gas manager. With regard to the average meter system, no doubt there did arise certain little irregularities; but so far as his company were concerned, they had reached that happy condition that they were more nearly paid

for the gas consumed than they ever could be under the old system. He felt persuaded that it would be a great benefit to gas companies generally if they could introduce the average meter system, inasmuch as they would not only thus get paid for the gas actually consumed, but they would get rid of the continual complaints of the local authorities in respect of the public lighting. He did not think he could enter very largely into the questions touched upon by Mr. Brett, further than to say that the system adopted with his company was this: They took charge of laying the services; after the services were laid the meters and fittings were provided by the local authorities, and there were very stringent regulations as to the maintenance and repair of these things. The company had an inspector in each district, whose duty it was to go round and see that everything was in good order. The meter, they found, was a great indicator of the state of the burners generally. They knew very well if the governors were properly constructed and well regulated, and were working well, on those lamps which had no meters, by the results indicated by those which had meters. They took out the meters once a year to test them, and they had an arrangement with the local authorities by which those bodies were required to test their governors once a year. It was also done occasionally by the company's own officers in conjunction with theirs, and such governors as were found to be slightly irregular, say, beyond one per cent., were taken out, re-adjusted, and set right. This continual readjustment secured for the gas companies, in his opinion, a much nearer approximation to a correct registration of the gas consumed by the public lamps than any otoer plan which had been adopted. As to the suggestion of a meter to every lamp, that, he thought, would be a very great and quite unnecessary expenditure, and as to the proposition of laying a separate main for the public lamp service, he did not think there would be much gained by it. The main would necessarily be smaller than that in use for the general consumption, and therefore more liable to breakage, more liable to leakage from the joints. Looking at the question from all points of view, he thought the system would be an extravagantly expensive one to adopt as compared with the system now in operation, and he should certainly expect to find that the unaccounted-for gas would be very much increased. He had some experience with small mains in London. A great quantity of them were laid down by the late Great Central Company, and when they came under his supervision some years ago, he found them to be in a terribly bad state indeed. He could not go a hundred yards, even where these mains were laid under the footway, without finding broken joints and much consequent leakage. As the fruit of his experience, extending over a long period and a considerable district, he was clearly of opinion that the adoption of a system of small mains for the exclusive service of the public lamps would lead to a large increase in the per centage of unaccounted-for gas. On the other hand, he was fully convinced that the adoption of the average meter system was the best solution of the difficulties hitherto experienced between the authorities and the companies in reference to the public lighting question.

Mr. CARR (Halifax) said he was one of those happy individuals whose lot it was to serve a corporation, and, therefore, it might be supposed that this question did not much affect him, but was only of interest to gas companies. Still, corporate officers were affected by it. The Lighting Committee of his borough were the Highway and Watch Committee; they bought gas from the Gas Committee for the public lamps, and some little differences arose at times as to the proper measuring of the gas, and the proper way of supplying it. The lamps were supplied on the average meter system, and there were governors to every lamp. The district was a very irregular one, and the pressure varied from 5-10ths to 50-10ths. He had lately been trying some experiments to ascertain the consumption of the public lamps. On removing the governors he found the average consumption throughout was 4·1 feet per hour, testing at 8-10ths pressure. When the governors were replaced, the consumption was 3·5 feet, on the average of the whole. He set a man to watch the metered lamps to see the exact time they were lighted and put out, and in that way he succeeded in getting another quarter of a foot per hour in those lamps. Something might be said about the meters taking off a certain amount of pressure, but still the pressure over the whole district was much higher than what he had been testing at, and it was one of the things he had not quite satisfied himself about, that governors could be so relied upon under varying conditions of supply, such as in his district. He was much pleased with the paper which had been read. It gave a large amount of statistical information, and furnished some interesting details of the various modes of supply adopted, from the most primary which was still retained in some places, down to the most improved plans which experience had devised. He agreed with the writer when he said that some burners were so defective that the companies lost half the gas supplied to them; but he did not agree in his further remark that the public reaped the benefit of it. In truth, no one derived benefit from it. The miserable burners employed in some towns for the consumption of gas in public lamps were a perfect disgrace at the present time of day. And in reference to the disputes which sometimes arose, he thought that if the local authorities better understood their business, and, instead of railing against the gas manager, would try and obtain information for themselves as to the best conditions of gas supply, not only would the companies be benefited, but the public would be better satisfied. There was one point in the early part of the paper to which he wished to refer. Mr. Brett, speaking of the importance of the preservation of the service-pipes, said the method he adopted was to mix a quantity of tar with the earth in which they were laid, so as to make a sort of tar concrete all round the pipe. He would like to ask Mr. Brett how many pounds of tar per yard he would require to imbed his pipes in, supposing tar to be a good thing to apply to wrought-iron services, which, he thought, was not quite proved. To him it appeared to be rather a lavish system, when tar commanded a high price, to employ it in the preservation of lamp services.

Mr. WARNER (South Shields) said he did not gather from the paper what proportion of metered to unmetered lamps the writer advocated. As to the laying of the services, there could be no doubt that if a thing was worth doing at all, it was worth doing well, and he could not understand that the lavish mode proposed, of pouring tar in unlimited quantities around the service-pipes, amongst a lot of loose damp earth, was at all comparable to the plan of laying the pipes in troughs, and filling them up with melted pitch. He quite agreed with Mr. Brett that the fittings should be entirely in the hands of the gas company. He had maintained for many years that they should have entire control over the gas. With reference to the cocks used for public lamps, many of them had no means of indicating whether the supply was on or off. He had had his furnished with a little pointer, which was turned upwards when the gas was on. In addition to the ordinary washer and nut, he had a thumb-screw, so that in cold weather the lamplighters could keep hold of them.

Mr. BATES (Worksop) said he thought that, when adopting the average meter system, the fewer meters in use the better. He would as soon have 1 in 20 as 1 in 12. As to having a separate main for the public lamps, he was sure it would not be worth the expense. It would, as Mr. Johnson said, add to the leakage considerably, and would yield no permanent benefit. Some three years back the lamps in his town passed into the hands of the local board, and there appeared to be a question whether they should buy the lamps from the bottom of the stand-pipes or from the main. He suggested that it should be from the bottom of the stand-pipe, but the chairman of the local board would have it from the main. He, therefore, inserted a clause in the agreement that the services should be thoroughly examined, and, if any defects were discovered, that they should be repaired at once; and that, if not attended to by the local authorities, they should be repaired at their expense by the company. He thought it was best to lay service-pipes in troughs filled with sawdust, and he could state that some taken up by him within the last six months, that had been laid nearly 30 years, were as good as ever. As to the position of the metered lamps, he regarded it as of little consequence; the registration would be nearly the same so long as good governors were in use.

Mr. G. ANDERSON (London) said he was not an advocate of the average meter system, and he felt bound to give his reasons for not adopting it, seeing that so experienced a man as Mr. Johnson had given in his adhesion to it. First, then, in order to be paid for all the gas supplied under that system, it was necessary to have in the mains an extra pressure of about 2-10ths beyond what was required when no meters were in use, and this additional pressure caused increased leakage at the unmetered lamps. He did not agree with the writer of the paper that the local authorities were ignorant. On the contrary, he found, as a rule, that they were very acute, and required a considerable amount of looking after. There was a gentleman present on this occasion who had the charge of lighting a large city of 100,000 inhabitants on the average meter system. This gentleman informed him that there was a continual complaint in the city that the local authority were in the habit of sending round and turning out the metered lamps an hour or two before the regular time, so that the gas company were put to the expense of having to employ men to perambulate the streets during the night to stop these proceedings. For such and other reasons he (Mr. Anderson) could not approve of the average meter system. He believed there were only two methods that could satisfactorily be adopted—one was the system very wisely advocated by Mr. Hawksley—that of having a meter to every lamp, or the laying down of a separate main for the public lamp service. He did not see that it followed there would be more leakage from having a separate main, because under that system a meter would be put down at the gas-works to measure all the gas supplied to the main, and it would therefore be to the interest of the local authority to see that the main was sound, and the company would be paid for all the gas registered as having passed the meter. But really it was not necessary practically to have a separate main in that broad sense. Why not have one meter in the middle of each street, with pipes supplying 10 or 20 lamps each, branching out from it, and one small main for each section. This would give almost the same result as now was obtained with a meter to every 10 or 12 lamps. No doubt, under the old system, the companies supplied much more gas to the public lamps than they were paid for, and it was important some improvement should be effected upon that state of things.

Mr. COLES (Todmorden) thought the public lighting would never be satisfactory until the supply of gas came under corporate management. One difficulty in connexion with the meter system was the influence of frosty weather upon the meters.

Mr. COPP (Watchet) said in his town, until about two years ago, the company entered into a contract for the supply of gas at so much per lamp, but since then the authorities had introduced the meter system with painful results to the company, for it had actually reduced their returns 50 per cent. The claim was set up on behalf of the local authorities generally, that because they were large consumers, therefore they should be supplied at a lower rate, the fact being lost sight of that each lamp, requiring a separate service, was a distinct source of leakage as well as expense. He thought more attention than hitherto should be paid to the burners employed in the public lamps.

Mr. WILKINSON (Harrogate) said he had had some little experience, not only with regard to the meter system, but also, for one year, in relation to the supply of the public lamps with petroleum oil. The company to which he belonged supplied the public lamps by contract for some years, using the best burners they could get, and they offered to furnish governors to the lamps and to keep them in repair, provided the commissioners paid the first cost of them. This they refused to do, and at last the parties got into such hot water, that the local authority determined to discontinue the use of gas, and light the streets with petroleum oil. He was glad they did so, and he would advise all his brethren in similar circumstances to let it be done; the authorities would soon get sick of the experiment. His company had always calculated that there was a very serious loss by over-consumption in the public lamps, when supplied without meters, and, in proof of that, he might mention that during the year the lamps were lighted with petroleum, the company were enabled, by the saving of gas alone, to pay half the bonus to their shareholders. Reference had been made to the difference between the metered and unmetered lamps—probably there was some little difference—but he believed that, where proper meters were used, and properly fixed and charged with glycerine and water, there was no danger of any great difference arising. The adoption of the average meter system in his town had given great satisfaction to the local authority, and to the company likewise. The former purchased the posts from the company, and laid their own pipes under the company's supervision, and under agreement that they should be such as met with their approval. The governors professed to fix the consumption at 5 feet per hour, and the experience of their working was that they gave an average result of 4¼ feet. The commissioners at one time had it in contemplation to lay a main of their own for the supply of the public lamps, and to take all the gas through a single meter. He wished they had done so, because then the company would have been saved all the leakage on the lamp-services; but they found upon investigation that the cost of such a main for their 330 lamps would have come to something like £3000.

Mr. EDWARDS (Thornton) had had the average meter system at work for three or four years to between 300 and 400 lamps. The company forced the adoption of it upon the authorities on their bringing against them a charge of fraud, and since the first quarter's bill went in there had not been a single complaint of any kind. In fact, every one was satisfied. With regard to the remarks made about the difference of consumption between the metered and unmetered lamps, he had taken a course different, perhaps, to some members. He tested every governor by putting it upon an experimental test-meter, and all those which would not stand an increase of 10-10ths of pressure, without altering the registration, he rejected. The result of that was that he had got paid for 93 per cent. of all the gas he made.

Mr. LIVESAY (Ventnor) differed from Mr. Anderson in reference to the average meter system, and was decidedly in favour of that mode of supply to the public lamps. For some years he was secretary and manager of the gas and water works in his town, and was also surveyor to the local board. The disputes and squabbles arising out of the contract system of lighting were interminable, and it appeared that the company could never give satisfaction. The local board consisted of 18 members; there were three newspapers in the town, and every member was fond of writing to them. The company lighted the lamps, cleaned them, extinguished them, and supplied the gas for about £3 per lamp per annum, during eight months of the year, every night, from sunset to sunrise, except five nights at the

full moon. About six years ago, when the contract was about to terminate, they intimated to the board that they could not renew on those terms, and suggested the adoption of the average meter system. Several interviews took place on the subject, and, as he had the confidence of both parties, he was asked to draw up an agreement. He did so, the arrangement was made, and they had gone on very amicably ever since. Under this arrangement, the company still had the control of the services from the main to the burner. The local board paid for the stand-pipes, governors, burners, &c., and kept them in repair. They also provided wet meters, specially adapted for the purpose, in cast-iron cases, which were fixed beneath the pavement. The number of meters was one to every six lamps. The district was a very heavy one, the variation in level from the sea being 360 feet. They had no governors. The local board kept the lamps in repair, lighted, cleaned, and extinguished them, and for the quantity of gas supplied they paid at the same rate as that charged to the private consumers. As he had already stated, there had been no dispute at all between the company and the board since this agreement had been made. But there was one circumstance which he thought had rather pleased the ratepayers, but about which he thought the local board had rather hoodwinked them. When the company lighted under contract at so much per lamp, they kept the lamps alight from sunset to sunrise, but directly the local board took the matter in their own hands the lamps were extinguished at one o'clock; now they were extinguished at eleven o'clock. The ratepayers, of course, had not so much to pay for the gas through this retrenchment; but the company had no reason to complain, as they received nearly as much for the public lamps now as they did when they were kept burning till daylight. As a word of advice to members, he would caution them, in adopting the average meter system, not to put too few meters, especially in some districts.

Mr. BRETT, in the course of his reply, said he did not think his plan of laying services was open to the observation of lavish expenditure, as he only used about a gallon of tar to every 10 feet of pipe, at a cost of about 2d. There was no necessity to fill the whole of the trench, but only just round the pipe, with the tar. He thought the general opinion in the meeting seemed to be in favour of the meter system, especially if governors were not used. As to the number, his own idea was that one to 14 lamps was sufficient, and this he found was above the average.

The PRESIDENT said the members generally would agree with him that they were much indebted to Mr. Brett for bringing forward this subject. His paper had elicited a great amount of information from one and another in the way of recapitulation of personal experiences, which, no doubt, would be of general benefit. It was a very fruitful subject, and had borne fruit in the way of suggestions as to what to do and what not to do, what rules to observe, what errors to avoid, and how best to meet difficulties in the supply of gas to the public lamps. With regard to Mr. Wilson's remarks, he (the President) did not sympathize in the notion of supplying the public lamps through a separate main. It would involve a very large expenditure, and the interest on the capital would more than balance any saving that could be effected, to say nothing about the additional leakage, and the friction which would take place in a small main of that kind. But this was a matter which each could settle for himself; given any town, to ascertain how much main would be required to be laid for this service, and how much the cost would be. In some cases he apprehended it would amount to half the cost of the public lighting. Looking at it from all points, he was not himself inclined to the adoption of this plan. On the contrary, he objected entirely to having two mains in the streets. It should be a great point with every company to have abundant main capacity. By using large mains instead of small mains, the unaccounted-for gas was reduced because the supply of gas could be given anywhere in the district at the lowest potential pressure—*i.e.*, the initial pressure at the works. This he held to be a very important consideration. Assuming the mains were properly laid and properly cared for, then he would say, "See how economically you can supply gas at the lowest pressure when the consumers are all gone to bed, and no one up but the public lamps." He knew from experience that very great economies had been effected by carefully watching the pressure after eleven o'clock at night. In some towns, of course, where a night train was due at twelve o'clock, that must be the time; but his advice was, wherever practical, reduce the pressure to the lowest point after your consumers meters have left off working. With regard to some remarks made by Mr. Anderson, it was a matter of congratulation to see Mr. Anderson in such excellent form. He was always vivacious and lively, and incisive; but, *query* whether the alteration in the old state of things ought not to modify one's old feelings of—well, he would not say unkindness, because gas men were never unkind to any one. But seeing that a great many corporations had bought works belonging formerly to companies, they might now be regarded as occupying the position of companies in former times. They were bound to manufacture and supply gas, and the Gas Committees had to see that the Lighting Committees paid for all they consumed in the public lamps, and it was a matter for congratulation that corporations had been brought to supply gas on sound constitutional principles. Now, with regard to the average meter system, which did not find favour with Mr. Anderson, he (the President) would say for himself that, having been a bitter opponent of it, and fought many battles for the companies against it, he now approved of it. Some 30 years ago, in a town with which he was connected, he found the old principle in vogue of bribing the corporation by supplying gas to the public lamps at a lower price than to the private consumer. His first stroke of business was to increase the charge to the public lamps 15s. per annum, and reduce the price to the private consumers. A meeting of the corporation was held, and he was asked to attend. There was a great deal of vigorous speaking, and when he got a hearing, he said: "I am not putting this 15s. into my own pocket; I am taking it from you and putting it into the pockets of the consumers, and I say that the old system of charging less to the public than the private consumers is not justice and equity. It is not a sound commercial principle that you should pay 4s. while the private consumers pay 6s. You say you are a large consumer, but I say that, taking each individual case—and I treat each lamp as a single consumer—you are a small consumer. You pay only £3 per year for each service, whereas I have consumers in this district who pay £150 for a single service. Although, therefore, we know that the corporation may always be relied upon to send their cheque to the secretary of the gas company as soon as the amount is due, yet there is the leakage on the public lamps to be taken into account—and service-pipes are a greater source of leakage than mains; therefore (I said) you must put up, for the common good, for the good of those whose representatives you are, with having a wholesome and honest and consistent state of things established." In that case the corporation were men of such common sense that they actually said "Amen" to everything he brought before them. And he believed managers would find, as he did, that, after all, common sense, if only applied properly, would prevail, and that if they did the thing that was right, they would in the end, to employ a rough expression, "shame the devil." It must be always borne in mind that the saving effected in the public lighting was a saving, not so much for the benefit of those who supplied gas, as in the interest of the consumers. Everything by which the company could economize, and by which their profits were improved, was so much to the good of the private consumers. A company might be able to sell gas at 6d. per 1000 less if they had not to maintain an unreasonable and stupid loss from the lighting of the public lamps. Therefore, in arguing the public lamp question, they were arguing a question in the consumers interest, and in which they were themselves disinterested. Referring to the observations of Mr. Johnson, the President said he had heard of Mr. Johnson as one of the best abused men in connexion with this matter, and, therefore, he was pleased to find that his troubles had not made him shrink away. It was good to see a well-abused man preserve such a rotundity, and retain a spirit so genial. Mr. Johnson spoke more strongly in favour of the average meter system than some others, and believed it to be the most conducive to a satisfactory settlement of all disputes between the companies and the local authorities. There was no doubt the system had had this effect; it had established the principle, brought it to the front, and confirmed it, that the public consumer, the corporation, or the local board should pay a price for the public lamps, not less and not exceeding that charged to the largest private consumer. This principle was now sanctioned by parliamentary procedure.

(To be continued.)

A NEW AND EXACT METHOD FOR THE DETERMINATION OF ALL THE SULPHUR IN ILLUMINATING GAS.

By T. O'CONOR SLOANE, A.M., E.M., Ph.D., Chemist of the New York Gaslight Company.

[Read before the New York Academy of Sciences, March 5, 1877.]

Many methods for the determination of sulphur in illuminating gas have been proposed. Two only are in general use—"Letheby's" and the "Referees" sulphur tests. In both of these the gas is burned, and the products of combustion brought into contact with ammoniacal gas. This condenses the sulphur dioxide and sulphuric acid formed in the combustion. The solution is washed out of the apparatus, and the sulphur which it contains determined. The efficacy of these methods depends upon the complete oxidation of the sulphur in the process of burning. No attempt is made in either to purify the air. Hence the operation has to be conducted in a room in which there is no coal fire, and in which no gas is burning. Even then the air may contain sulphur, as sulphur dioxide, or sulphuretted hydrogen; and this is most to be feared in the vicinity of factories, or in large cities, precisely the places in which these determinations have to be made. Then, in the case of the Letheby apparatus the flame is liable to be extinguished by draughts. I have never used the Referees apparatus, but should imagine that it was to some extent open to the same objection.

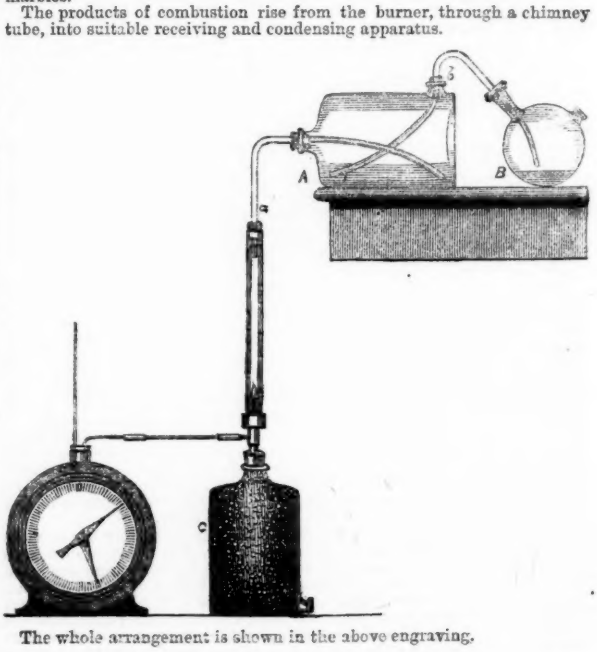
I am of opinion that the most practicable method of determining all the sulphur contained in gas is by combustion. This being admitted, the following requirements are essential:—1. All of the sulphur in the gas, and no more, must be collected. 2. The air must be purified from any sulphur which it may contain. 3. The apparatus should be simple, and require for its construction no special forms of glass. 4. The flame should be protected, so that it will not be seriously affected by draughts, such as may be caused by opening or shutting doors close to the burner. 5. No aspirator should be employed.

In the apparatus here described all these points are met.

The gas is burned in a Bunsen burner, the foot of which is unscrewed, and a tube of about 16 m.m. internal diameter is soldered around it, leaving an annular opening. This tube rises to within 25 m.m. of the top of the burner, and descends 75 m.m. below its bottom. Before fastening it in position all of the air-holes of the Bunsen burner, except one, must be soldered up. This should be one-half closed. The air-tube then has a cup fastened around it, making a second annular space, only, in this case, a closed one. It should be 50 m.m. deep and 50 m.m. wide. Its top should be a little lower than the top of the air-tube. If the cup be filled with water, the burner lit, and a chimney placed over it, resting in the cup, all the air consumed by the burner must rise through the air-tube. Below the burner it may conveniently be reduced to one-half the diameter given. I also advise that the air-tube be made to unscrew, just above the burner nipple. Then the supply of air to the interior of the burner can always be regulated by partly closing the one air-hole with sealing wax or gummed paper.

The air is purified by potassic permanganate. A bottle, tubulated at the bottom, and of six litres capacity, is filled with small marbles, or broken glass, or a mixture of both, and a solution of permanganate spread all through it. Its upper neck is supplied with a perforated cork, which receives tightly the air-tube of the burner. Thus the bottle supports the burner and acts as an air purifier. It will be seen that all the air which passes through the air-tube must first pass through the glass and marbles.

The products of combustion rise from the burner, through a chimney tube, into suitable receiving and condensing apparatus.



The whole arrangement is shown in the above engraving.

The chimney tube must be of thin glass, and not over 32 m.m. in diameter; 25 m.m. is a good size. The sides must be straight, and it may be 380 m.m. to 420 m.m. long. A tube of 14 m.m. to 17 m.m. in diameter, bent exactly as indicated, is fitted into its upper end with a perforated cork. The heat is rather hard on the cork, so the best quality should be employed. This tube passes into the tubulated bottle, A. The bend must be smooth, and the tube must slope down from this bend into the bottle. Thus, any water which may condense in it will flow away from the burner. If any ran back, it might crack the tube or chimney, or put out the burner.

The bottle, A, is an ordinary tubulated bottle, of 5 or 6 litres capacity. It rests upon its side, and should be secured in position with some wedges, or weights. One must be selected whose lower neck is of large diameter. The exit tube is of 13 m.m. internal diameter. It runs forward and to within 30 m.m. of the lower side of the bottle, A. Its shape can be seen in the figure. It enters the receiver, B. This may be of a litre capacity. I employ a tubulated retort receiver, but any bottle will answer, and a hole in the cork is sufficient to permit the escape of the gas from the combustion. If a flask be employed, no cork will be required. The flask can be fixed in position, so that the tube will reach nearly to its bottom.

By an eduction-tube, of large size, 50 m.m., tin or iron, the fumes may be carried off if this be desired.

The gas, whose temperature should be noted from time to time, is burned at the rate of 0·8 cubic foot per hour. A solution of potassic permanganate, with an excess of hydrochloric acid, is contained in the receivers, A and B. The products of combustion pass over this solution, and are acted on by the chlorine, nascent and evolved; 95 per cent. of the sulphur will be absorbed in A, the remainder in B.

I will now give the details of the manipulation, and the minor adjustments.

The meter is put in position, levelled, and the water-line adjusted. A good wet meter is a very satisfactory measurer of gas, and is more convenient and portable than a graduated gasholder. Its connexion with the gas-main should be as short as possible, and all metal or glass. India-rubber connexions should be few, and the ends of tubes so connected should be in contact. If the connexion with the main be through a long service-pipe, gas should be permitted to escape from it before and during the entire experiment, so as to ensure a fresh supply. In a laboratory, the regular burners which are in use will secure this end. The burner is in like manner connected to the outlet of the meter. The gas is now turned on, lighted, and permitted for a while to burn at its full capacity. It may temporarily be supported on a ring-stand. This expels all old gas or air from the meter. The purifying bottle is now charged.

Ten or fifteen grammes of permanganate are dissolved in about 200 c.c. of water. The solution is poured into the bottle. Both necks are tightly corked, and the whole is turned over and over in every direction, until the solution is spread all over the surface of the glass and marbles. The bottle is then placed by the meter, the corks removed, and the burner fixed with its cork in the neck.

Two solutions of permanganate must now be made. Each one must contain one gramme of the salt for every two feet of gas which it is proposed to burn in the experiment. This is the minimum. Twice the quantity would not be too much for the receiver, A. It should be dissolved in distilled water, about 70 c.c. to the gramme being employed. As an allowance has often to be made for the sulphur contained in the permanganate, it should be weighed out for each experiment, not guessed at. These two solutions are now poured, each into one of the receivers. For each gramme of permanganate 2 c.c. concentrated hydrochloric acid are added, and the whole slightly shaken. The tubes are now put in position. The chimney, for the present, passes down by the side of the burner. Its position is adjusted by moving it up and down on the tube *a*, so that when it rests on the bottom of the burner cup, the far end of the tube *a* will be 13 m.m. above the surface of the liquid. The near end of this tube should descend some distance, 10 to 20 m.m., below the cork in the chimney-tube.

The gas-cock is now adjusted so that the gas will pass the meter at less than the ultimate rate. It may afterwards be brought up to nearly a foot, and this rate should not be exceeded. The meter reading is taken, the whole absorption apparatus lifted up quickly and set down gently, with the chimney-tube over the burner. There will be a slight error in the meter reading, owing to the time required for this operation, but it can be allowed for. The burner cup is now filled with water. Here care must be taken, or by pouring against the hot chimney-tube it will be cracked. Another precaution is to avoid dipping the end of tube *a* or *b* into the solution, or, of course, the flame will be extinguished. The combustion now goes on quietly, and after enough of gas has been burned, 1 to 5 cubic feet, it may be turned off, the solutions washed out into a beaker, and the sulphur they contain determined. The solutions, on removal, should still be violet in colour.

The easiest way of getting rid of the excess of permanganic acid is to add and heat with a little alcohol. The precipitated brown oxide of manganese dissolves with difficulty, but hard boiling and a large excess of hydrochloric acid will do it. It is well to let it settle, decant the supernatant liquid, and then dissolve the precipitate. It is very slow work to filter it all out, so its solution is be recommended.

There are only two ways in which any sulphur can escape collection in this apparatus. One is insufficient oxidation, the other insufficient condensation.

To investigate the first of these points I employed an apparatus essentially the same, but supplied with air by an aspirator. Thus I could measure pretty closely the relative volume of air to gas, and I found that it made very little difference whether the gas was burned with five or ten times its volume of air. By calculation from analysis it appears that to completely burn gas, 1·16 to 1·18 parts of oxygen are required, or six parts of air to one of gas.

I here give some of these results; the sulphur I express in per centages, taking the highest result obtained as 100 per cent.:—

Gas.	A.		B.		C.	
Feet of air to one foot of gas	6·6	10·0	5·2	10·2	9·1	5·5
Per centage of sulphur	100·0	98·6	96·8	100·0	100·0	96·5

These, with other results, will be found tabulated at the end of the paper.

This proves that the sulphur will be perfectly condensed within very wide limits of oxidation. I may observe that 1 per cent. of sulphur on the quantity of gas I employed for each experiment was represented by less than three milligrammes of baric sulphate.

To prove that the condensation was perfect, I performed the following experiments:—I made sulphur determinations with the apparatus arranged as shown in the engraving, but in place of the receiver, B, I used an ordinary wide-mouthed bottle, which I shall still designate as B.

	Exp. 1.		Exp. 2.
Per cent. of sulphur in A	95·54	..	97·87
Per cent. of sulphur in B	4·46	..	2·13

Finally, to try how perfectly the air was freed from sulphur by the purifying bottle, C, I passed air over a surface of a strong solution of sulphur dioxide, through the bottle in question, and then through the receiver, A, containing the acidified solution of permanganate. Air was passed through at the rate of about 10 cubic feet per hour, and only a trace of sulphur could be found; this trace I attribute to the permanganate. Air was passed through at the rate of about 10 cubic feet per hour, and only a trace of sulphur could be found; this trace I attribute to the permanganate, which contained 53-1000ths of 1 per cent.

Now, the amount of sulphur which coal gas in England may contain under the law is 20 grains per 100 cubic feet. An error of 5 per cent. would here involve the question of only one grain, and of all the experiments quoted none has so large an error. The average difference is only 3 per cent. For the Referees apparatus it is claimed that it will show 20 to 30 per cent. more than Letheby's. Compared to this difference, 5 per cent. even seems a small discrepancy. It may be noticed that the highness of the results was independent of the amount of air.

The receivers may be placed on a table, and the meter and purifying bottle on the floor. The dimensions given favour such a disposition.

I give below a number of results obtained with a slightly different absorption apparatus. In conducting the experiments leading to them an aspirator was employed giving a close approximation to the amount of air consumed.

A.

Date, 1876.	July 10.	July 17.	July 18.	July 20.	July 21.	July 24.	July 26.
Gas, cubic feet per hour.	0·60	0·70	0·77	0·59	0·59	0·70	0·55
Rate of air to gas . . .	8·25	9·1	5·4	5·8	6·4	7·3	9·4
Cubic feet of gas burned.	1·00	1·00	1·00	1·00	1·66	3·00	3·00
Sulphur, grains . . .	12·7	15·2	13·9	13·8	13·9	13·4	14·0

B.

Date, 1876.	Aug. 22	Same.	Aug. 23	Same.	Aug. 25	Same.	Same.	Aug. 26	Same.
Gas, cub. ft. per hour.	0·97	0·625	—	0·895	0·652	0·985	0·659	0·723	1·64
Rate of air to gas . .	6·6	10·0	10·2	5·2	8·9	4·7	9·8	9·1	5·5
Temperature . . .	80°	80°	83°	83½°	86°	88°	88°	81°	83½°
Sulphur, grains . .	14·1	13·9	16·2	15·7	15·1	15·3	14·5	16·3	15·7

ON THE GASES ENCLOSED IN LIGNITE COAL AND MINERAL RESIN FROM BOVEY HEATHFIELD, DEVON.

By Mr. J. W. Thomas.

[A paper read before the Chemical Society, June 7, 1877.]

Four samples were examined. No. 1 lignite consisted of the leaves and stems of plants in a closely compressed condition, and is known locally as "leafy coal." No. 2 lignite—dense, compact, of a distinctly woody character, and dark brown. No. 3 lignite was very dense, but earthy and wet in appearance, the cleavages being much encrusted with hydrated oxide of iron; in colour it was nearly black. No. 4. mineral resin retin-asphaltum—soft, brown, powdery, lighter than water.

No. 1. Leafy coal from Bovey Heathfield.—100 grammes after heating to 50° for 12 days, gave 56·1 c.c. of gas, containing—CO_2, 87·25; O, 0·24; CO, 3·59; OH_2, 8·92 per cent. After heating to 50°, 100 grammes were heated to 100° for 18 days, and yielded—59·9 c.c. of gas; CO_2, 89·53; CnH_2n gases, 0·33; CO, 5·11; N, 5·03 per cent. On raising the temperature to 150° decomposition set in, and the pellets of mercury in the Sprengel became blackened by the formation of sulphide of mercury. The gas given off had at first an aromatic odour, but afterwards became exceedingly disagreeable from the presence of organo-sulphur bodies, mercaptan, sulphide of allyl, &c. At 200°, more than 18 c.c. of gas were collected, the last portions of which contained CO_2, 62·06; OH_2, 2·62; CO, 14·00: C_2H_4, 0·49; C_3H_6, 0·48; N, 0·27 per cent. Above 250° it was impossible to collect any gas, the action of the sulphur compounds on the mercury being so energetic as to block the Sprengel.

No. 2 Lignite—100 grammes, at 50°, evolved 48·5 c.c. of gas, consisting of—CO_2, 96·23; O, 0·11; CO, 2·42; CnH_2n gases, a trace; nitrogen, 1·24 (the first portion of gas which came off contained 16·23 per cent. N). At 100° sulphur sublimed in small yellow crystals; the lignite began to decompose at 185°. At 200° the gas consisted of CO_2, 86·30; CO, 7·41; CnH_2n gas, 2·08; marsh gases, 3·34; hydride of propyl, 0·53; nitrogen, 0·34 per cent.

No. 3 Lignite began to decompose at 180°; the gas evolved at 200° consisted of SH_2, 0·41; CO_2, 91·68; CnH_2n, 0·41; CO, 7·12; H, traces; N, 0·38 per cent.

No. 4. Mineral resin from Bovey Heathfield.—At 50° a very small quantity of gas was given off. At 100°, 21·4 c.c. of gas from 100 grammes came over; CO_2, 88·24; O, 0·23; CnH_2n, 0·47; CO, 7·90; N, 3·16 per cent. At 110° to 120° it began to melt and decompose, the sulphur compounds coming off so rapidly as to block the pump. When the temperature was raised to 160°, about 180 c.c. came over, consisting of SH_2, 0·41; CO_2 78·88; CnH_2n gases, 2·07; CO, 7·82; marsh gas, 8·05; hydride of propyl, 1·86; nitrogen, 0·31.

When compared with the coals of the carboniferous period, it is seen that, as far as the occluded gas is concerned, these lignites resemble most cannel coal, but contain CnH_2n gases, and only matters of the aromatic series instead of gases and compounds of the paraffin series. The lignites are far less stable *in vacuo*, decomposing below 200°, whilst the true coals usually resist a temperature of 300°. The existence in Nos. 1 and 3 of organo-sulphur compounds in the presence of hydrated oxide of iron suggests that the iron pyrites of true coal may have derived their sulphur from that existing in organic combination in the plants from which coal is produced, and not from the reduction of sulphates. The author concluded by pointing out the extremely hygroscopic nature of the Bovey lignites.—*Chemical News.*

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There has been another very quiet week in all branches of the iron trade, and no changes, of any real signification, have taken place either as to the demand for, or the prices of iron. The pig iron smelters now hold their production steadily, at the prices quoted several times recently in these notes, but users are not content to buy except at a reduction of at least 6d. to 1s. per ton. Vendors are very unwilling to fetter themselves for longer periods than about three months, whilst buyers, allege that they would rather buy from hand to mouth during the summer months, when their needs will be by no means pressing. Under these circumstances, the quantities which change hands are of limited size, and are almost all made the subjects of special negotiations and prices. The same rule holds good as regards finished iron and foundry products, neither of which are in such good request as they were a couple of months back. Some of the manufacturers of merchant iron allege that they can now make and sell ordinary bars at a profit; but it is confessedly difficult to see how £5 17s. 6d. or £6 can be made to pay, even if the makers possess their own ironstone mines and blast furnaces. It is, at all events, pretty certain that no producer can now afford to buy pig iron in the open market, and expect to get any profit on it when turned into merchant iron. The foundry

branches afford exceptions to this assertion, inasmuch as many of the smaller foundries are kept going on patent and other special articles. At the larger concerns which have foundries attached there is still some semblance of briskness, chiefly on colliery castings and large sized mains for gas and water works uses.

The coal trade is not so well supplied with orders as it was last month, and shipments from the Humber ports are consequently falling off. Last month there were over 19,000 tons exported from Hull, Grimsby, and Goole, the two first-named places having the lion's share. At several of the local collieries strikes exist in opposition to reductions of wages, ranging from 6d. to 2s. weekly. House coal is almost wholly neglected, but steam and gas coals are in fair request at 6s. to 9s. 6d. per ton at the pits.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is no very material change to notice in the position of the coal trade of this district, except that engine classes of fuel and slack especially exhibit a decidedly upward tendency in price, new customers having in many cases to pay an advance upon late rates before they can obtain supplies. In the round coal trade there is only a moderate amount of business doing, the warm weather having considerably reduced the requirements for house fire purposes, and although the pits are still stopped in West Lancashire, there is no pressure of orders in the market, and prices, though firm, are no higher as a rule. Good Arley coal at the pit mouth can be bought at 10s. to 11s. per ton; Pemberton four-feet, 8s. 6d. to 9s.; and common coal, although not offering at quite such low prices as were ruling last month, at 7s. to 8s. per ton. For burgy and slack, advances of from 3d. to 6d. per ton are being obtained, and the average pit quotations are 5s. 6d. to 6s. 3d. per ton for burgy, and 4s. 6d. to 5s., and 5s. 3d. per ton for slack.

In the shipping trade there is scarcely anything doing, the West Lancashire colliery proprietors, in consequence of the strike, reserving what stocks they have for their regular customers, and most of the vessels in the Mersey are getting their supplies from Birkenhead.

The West Lancashire colliers are now in the third week of the strike, and they still evince a determination to hold out unless the masters agree to arbitration. On the other hand, the masters show no signs of giving way, and at present they, in most cases, are able to meet the requirements of their regular customers from the stocks they have on hand, but these cannot last much longer.

The iron trade continues in a very depressed condition, and north country brands of pig iron are still being pushed here at extremely low prices, the local smelters, indeed, being undersold in the immediate vicinity of their own works. In finished iron, however, Lancashire makers are able to hold their own against the Middlesbrough firms, who, at present, are doing little or no business in this district; local bars, delivered into the neighbourhood of Manchester, being offered at £6 12s. 6d. per ton. The Lancashire forges, however, are very short of work, and both founders and engineers are, as a rule, only partially employed.

THE COAL AND GENERAL TRADE OF THE NORTH.

(FROM OUR OWN CORRESPONDENT.)

The shipments of gas coals from the Tyne Dock, notwithstanding that we are close upon Midsummer, are remarkably well maintained. In point of fact, they are very large; 36,000 chaldrons of coals were shipped from the Tyne Dock last week, the bulk of which were gas coals. Where all the coals find a market it is difficult to say. The prices remain about the same. They are about 8s. 6d. best, and from 6s. 6d. to 7s. seconds. The steam collieries have now got fully settled to work. There have been considerable arrivals of large ships, amongst them a fleet of Dutch East Indiamen, which have come to the Tyne to load steam coals. The first-class collieries are fully employed, and the second-class pits are doing very well also. The prices of steam coals are 12s. best and 10s. seconds. The coal trade of the Tyne will be kept back a good deal this week through Newcastle races. Most pits are off work for two or three days.

The freight market is quiet. The supply of tonnage is quite in excess of the demand at present. Rates for steamers to load coals to the Baltic fell £1 per keel last week, and very little was done with the Mediterranean. All the coasting ports accessible to steamers are extremely well supplied with tonnage, and generally the market is favourable to shippers. Within the past month or so a considerable quantity of gas-retorts and other fire-clay goods have been shipped from the Tyne to British America, mostly to Montreal. It looks as if the British-American gas companies were taking advantage of the moderate price of manufactured goods in this country, and were renewing their plant.

The iron trade of the North of England is unchanged. The market is very quiet, and only a limited business is done. The chemical trade is not so strong as it was ten days ago. The then advance of prices seems to have been due to "bulling" operations. Some merchants, it is stated, have rather burnt their fingers through them. The importation of timber has been pretty large within the fortnight; but the general building trade of the North of England is falling off considerably.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

On the 18th inst. the annual meeting of the Muirkirk Gas Company was held—Mr. C. Howatson in the chair. From the profits of the year ending the 31st ult., a dividend of 10 per cent. was declared to the shareholders, and £58 11s. 6d. carried to the fund for repair of works. The price of gas was continued at last year's rate—namely, 5s. 5d. per 1000 cubic feet. It may be remembered that a second gas supply undertaking was commenced in Muirkirk some months ago by the Eglinton Iron Company (Messrs. William Baird and Co.), for the convenience of their works and offices and their *employés*.

The annual meeting of the Dundee Gas Commissioners was held on Wednesday last. Ex-Bailie Edward, in submitting the estimates for the current year, mentioned that they began last financial year with a surplus of £437, and ended with a surplus of £1964. The amount of gas manufactured during the year was 292,000,000 cubic feet, the quantity sold being 242,170,000 cubic feet. It was estimated that 30,000,000 cubic feet of gas would be required for this year, which would yield a revenue of £58,826, and the expenditure was reckoned at £58,698. He moved that the price of gas for the current year be reduced from 4s. 5d. to 4s. 2d. per 1000 feet, with 5 per cent. discount for payments within 28 days; that the price for gas supplied at Invergowrie and Harecraigs be 5s. 2d., and at Downfield 6s. 8d.; and that the gas for the public lamps be charged 3s. 11½d. without discount. The motion was unanimously agreed to. It is remarked by the leading local paper—the *Dundee Advertiser*—that the reduction in price now announced has been, to a considerable extent, brought about by diminished leakage. Mr. M'Crae is urged to persevere in this direction, the editor being of opinion that the leakage has even yet scarcely been reduced to a minimum.

A meeting of the Forfar Gas Commissioners was held on Monday, the 18th inst., when Bailie Lowson's proposal to appoint a Gas Examiner to report at stated intervals on the quality of the gas supplied to the consumers was considered, the salary not to exceed ten guineas per annum. The motion was not seconded. It was reported that during the year 1875-76 there had been sold 17,901,040 cubic feet of gas, while the amount sold during the year 1876-77 was only 17,211,950 cubic feet. Before passing away from Forfar and Bailie Lowson, the convener of the Gas Committee, I may mention that in the action at law for defamation of character raised by that gentleman against Mr. Rutherford, town councillor, in which the jury found for the defender, parties were heard in the First Division of the Court of Session on Saturday, on the question of an application for a new trial. The Court refused the application.

The annual meeting of the Catrine Gas Company was held last Tuesday evening. The treasurer's report showed a balance for the past year against the company, but that was due to the fact that certain alterations and improvements were in progress, part of which had been paid from the year's revenue. A divided of 5 per cent. was declared, and it was agreed to borrow money to meet the cost of improvements being carried out, and which, it was expected, would place the works in a much better condition.

A dividend of 5 per cent. has been declared by the Nairn Gaslight Company. Had it not been for a recent accident at the works, the dividend would have been higher. The Doune Gas Company have declared a dividend of 3 per cent., and the Auchtergaven Gas Company one of 2½ per cent., after laying aside one-fourth of the profits to the reserve-fund.

The Bathgate Gas Company have reduced the price of gas from 5s. 6d. to 5s. per 1000 cubic feet.

On Tuesday last the usual report by the city gas analyst was submitted to the Town Council of Edinburgh. It showed that on the 12th inst. the Edinburgh Gas Company's gas had an illuminating power of 26 standard candles, and that of the Leith Company 25 candles.

The application of the Johnstone Police Commissioners to the Johnstone Gas Company to negotiate a transfer of their works to the municipal authorities has resulted in the gas company signifying their willingness to treat with the commissioners in order to effect a sale. The matter will be brought before the Police Commission at an early date, when steps will be taken to complete the transfer.

At the last meeting of the Gas Committee of the Dumfries Town Council the clerk was instructed to intimate to the gas company that the council were prepared to treat for the acquisition of their works and lands, and to correspond with Mr. M'Crae, gas manager, Dundee, and ascertain from him on what terms he would revisit Dumfries, and again report to the committee what sum he would advise them to offer the gas company for their undertaking.

The annual meeting of the Bankfoot Gaslight Company was held last Wednesday, when the directors submitted their report. It contained a recommendation that the dividend for the past year should be fixed at 2½ per cent., which was approved of. The price of gas still remains at 10s. 10d. per 1000 cubic feet. Surprise is expressed at the fact of so few of the shareholders who are consumers taking any interest in the management of the company, and endeavouring to reduce the price of gas in accordance with the reduction in the price of coal. It is stated that the meeting was rather stormy.

A special meeting of the Glasgow Corporation Water Committee was held on Monday, the 18th inst., when there was submitted an abstract statement of the revenue and expenditure for the year 1876-77. The revenue amounted to £136,203 15s. 8d., and the expenditure to £119,887 18s. 9d.—leaving a balance to go to the sinking-fund of £16,315 16s. 11d. It was stated that these figures were very close to the probable estimate made in the spring of last year. The revenue had exceeded the estimate by £4808, the gain being principally on trade charges, and the expenditure by £2240, arising mainly from extra castings which have been found necessary. It was explained that trade had been better during the latter part of the year than they had anticipated when making up the estimate, and a larger sum had consequently been drawn from meter accounts. In the last quarter of the year it had fallen off again, and the receipts from trade charges had been reduced by £300. The domestic rate was steadily increasing. There was an increase of £4981 in revenue, and of £13,244 in the expenditure over the former year—the latter increase being due to the laying of pipes in Bridgeton district, for the better supply of water in case of fire. On the the motion of Mr. Osborne, the accounts were passed.

The superintendent of the Kirkintillock Water-Works reports that, as the result of a test recently made, he had found the consumption of water throughout the area of supply to be equal to an average of 11¾ gallons per head over a population of 8000. The supply continues to be fully maintained, and the works are in excellent order.

Very slow progress is being made with the Dour Water-Works for the supply of Burntisland, owing to the occurrence of numerous springs in the bed of the reservoir, which must all be puddled with clay. It would thus appear that instead of too little water, too much is to be the complaint.

On the 9th inst. the store-ponds from which Dunfermline is at present supplied with water were 18 inches down, and the quantity in store was equal to 118 days supply. The rain-gauge showed that the rainfall during May was 2·20 inches, as against 1·40 inch in May of last year.

On Friday last the Perth Water Bill was under the consideration of a committee of the House of Lords, and further opposition was given. The opponents of the measure petitioned the committee to insert a clause in the Bill naming the Police Commissioners as the first commissioners under the Bill, in place of the commissioners named by the promoters. After hearing evidence, the committee announced that they adhered to the Bill. They thought the promoters, who had borne the burden and heat of the day, were fairly entitled to consideration, and that the works would be better carried out if entrusted to their hands than to those of a body previously opposed to them. In September, 1878, the Act will be administered by the Police Commissioners, and the committee ordered a clause to be altered so that they should not be subjected to expenses as to salaries, &c., over which they had no control when arranged.

At the last meeting of the Dumbarton Water Commissioners, Mr. Cameron, the inspector, reported that there the supply of water in store amounted to 51,000,000 gallons—16,000,000 gallons in the Garshake reservoir, and 35,000,000 gallons in the Blacklinn reservoir. He had supplied eight additional public works with meters, and was authorized to provide meters for other two works.

A good deal more activity was shown in the Glasgow pig iron market during the past week, and a large amount of business was done. The market closed on Friday—sellers at 54s. 6d. cash, and 54s. 7½d one month, buyers 1½d per ton less. On the week there was an improvement of 7½d. per ton.

The coal market is still dull, notwithstanding the advance of wages given to the colliers in some districts. House descriptions are slow of sale, and the local trade is otherwise dull. Shipping is not above the average, and prices remain unaltered.

NAPHTHA EXPLOSION NEAR THE NEW YORK METROPOLITAN GAS-WORKS.—On Monday, May 28, an explosion took place near the works of the Metropolitan Gaslight Company, foot of Forty-second Street and North River, which resulted in the death of three persons, and the severe injury

of a fourth, the latter being the only *employé* of the gas company that suffered. The facts of the case are as follows:—A lighter came to the company's dock to deliver a cargo of naphtha. The usual method is to deliver the naphtha from a tank barge by means of a hose, attached to the company's pump, by which the oil is forced into tanks on the company's premises; but, for some reason or other, on this occasion the cargo, consisting of about 100 bbls. of naphtha, was brought in barrels, and not in bulk, in the hull of the vessel. To enable the company's pump to receive it, the contents of the barrels, after removing the bungs, was run into a large cask or hogshead, by means of an open trough, and then the hose was put into this cask and the pump started. No sooner had the pump been set in motion than an explosion was heard, and the whole mass was in a blaze. The energetic action of the company's officers, in applying the fire hose, saved what otherwise would have been a very serious conflagration, probably resulting in the destruction of the trestle work and coal sheds which were adjacent. The three men killed belonged to the boat. The coroner is giving the matter a thorough investigation, and his report may throw some light on the cause of the sad accident, which, from all that can now be gathered, was undoubtedly a match or lighted pipe in use by some of the boat's crew. We are told that naphtha is perfectly safe. So it may be if nothing happens to set it off. But, certainly, any such method of handling it, and pouring it about loosely, is not to be commended. This matter, however, would seem to be something entirely beyond the control of human intelligence. Men get perfectly careless after constant handling of any dangerous material, and if the captain of a lighter sees fit to go sailing up the North River with a lighted pipe in his mouth, and the air about him full of naphtha vapour, it is somewhat questionable if any one is very anxious to go near enough to him to knock the pipe out of his mouth. From all that we can learn in this case, every precaution is taken in the handling of the material by the company after they get it in their possession; but does the risk and danger involved in the use of naphtha as an enricher pay? It would seem that, at the present price of coal, there must be an enormous margin of profit in using oil to compensate for the anxiety and danger, both to life and property, which must inevitably accompany it.—*American Gaslight Journal.*

Sue-Wealden Exploration.—The final report of this undertaking has just been issued by Mr. H. Willett (honorary secretary). He reports that the depth attained on the 21st of December last year was 1823 feet, and on the 12th of April 1905 feet. On the last-mentioned date a letter was sent by the Diamond Boring Company, stating, "We have used our best endeavours to reach a depth of 2000 feet, and have failed, owing to the want of lining permitting the hole to fall in on our rods and jambing them." It also stated, "There will be no difficulty at all in continuing the hole, subject to the arrangements being made for lining and the use of a big machine, which were submitted by Major Beaumont on the 26th of February." It was decided, however, not to make any renewed efforts. Mr. Willett writes: "The Sub-Wealden exploration is, therefore, brought to a close, and has proved conclusively that in the lowest part of the Wealden area no Palæozoic rocks exist within 1900 feet of the surface. That the search was justified, and that the scientific deductions of Professor Prestwich, F.R.S., were entitled to the highest consideration may be found in the fact that Palæozoic rocks of the Devonian period have been discovered (containing spiriferæ) in the boring made at the brewery of Sir Henry Meux and Co., at the corner of Tottenham Court Road, London. The following are the approximate measurements of this boring, the surface of which is about 70 feet above high-water mark:—Strata above the chalk, 159 feet; chalk, 653 feet; upper greensand, 28 feet; gault, 160 feet; lower greensand, 130 feet; Devonian (about), 40 feet—total, 1170 feet." Mr. Willett adds: "The search should, therefore, undoubtedly be further promoted in the valley of the Thames, and at other points in the south-east of England."—*The Times.*

Erratum.—Southwark and Vauxhall Water Company's Meeting.—*In our report of the proceedings in last No.* (*on page* 980, *col.* 1, *line* 7) *the word "important" was printed for "impertinent." The error occurs in that portion of the chairman's speech in which he was illustrating the spirit in which the company were treated by the Richmond Vestry. The chairman, feeling most anxiously for the inhabitants in case such a calamity as fire should be added to their existing difficulties, wrote to inquire if the vestry were prepared for such a contingency—an inquiry which was characterized by the chairman of the vestry as "impertinent."*

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2353.—Swan, J. W., Newcastle, and Stearn, C. H., Rock Ferry, Cheshire, "Improvements in Sprengel pumps." June 16, 1877.

2362.—Wallace, R. W., Battersea Park, and Claus, C. F., Great St. Helen's, London, "Improvements in the purification of gas and the utilization of bye products by the manufacture of secondary products therefrom." June 16, 1877.

2373.—Nawrocki, G. W. von, "Improvements in furnaces for the manufacture of illuminating gas, partly applicable to furnaces for heating purposes generally." A communication. June 19, 1877.

2381.—Leaver, J. C., Barnes, Surrey, "An improved combination of valves for machines used in compressing air and other gaseous fluids." June 19, 1877.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

4774.—Bartlett, G., Dulwich Road, Surrey, "Improvements in filters for filtering water." Dec. 9, 1876.

4805.—Werdermann, R., Princes Street, London, "Improvements in electric lighting apparatus." Dec. 12, 1876.

4816.—Blamires, T. H., Huddersfield, York, "New or improved means and apparatus for automatically opening and closing taps, valves, ventilators, and other similar purposes." Dec. 13, 1876.

4830.—Bromley, U., Crowe, G., and James, W., Chester, "Improvements in and relating to motive-power engines and pumps, applicable also in part to water-meters." Dec. 14, 1876.

4844.—Preston, F. P., Prestige, J. T., and Preston, E. J., Deptford, London, "Improvements in apparatus for regulating and controlling the flow of water and other liquids, and preventing waste of same." Dec. 14, 1876.

4909.—Harris, H. G., Westminster, "Improvements in steam-pumps." Dec. 19, 1876.

4916.—Dugard, W. H., Birmingham, "Improvements in fans for blowing, which improvements are also applicable to fans for exhausting, and to centrifugal pumps." Dec. 20, 1876.

4917.—Gill, J., Bridgnorth, Salop, "A new or improved gas-stove." Dec. 20, 1876.

4967.—Storer, J., and Pugh, C. H., Stafford, "Improvements in retort-lid fastenings." Dec. 23, 1876.

4983.—Goodfellow, G. B., Hyde, and Hallam, S., Stockport, Chester, "Improvements in steam-pumps, and in actuating the valves of steam-engines." Dec. 23, 1876.

4987.—Hallewell, R., Blackburn, Lancs, "Improvements in gas motor engines." Dec. 23, 1876.

4988.—Hallewell, R., Blackburn, Lancs, "Improvements in gas and water motor engines, and in gas-motor engines." Dec. 23, 1876.

8.—Stitchbury, F., Leyton, Essex, "An improved method of heating box-irons by a mixture of gas and air." Jan. 1, 1877.

431.—Pope, J., Folkestone, Kent, "Improvements in taps or cocks, which improvements are also applicable to regulating the flow of water to water-closets and other like receptacles." Feb. 1, 1877.

995.—Caldwell, A., Renfrew, N.B., "Improvements in apparatus for measuring and controlling or regulating the flow or supply of water." March 13, 1877.

1428.—Johnson, R., Manchester, "Improvements in machinery for pumping, forcing, blowing, and exhausting air and other fluids." April 12, 1877.

1462.—Livesey, J., Westminster, "Improvements in filters for water and air." April 13, 1877.

NOTICE OF APPLICATION FOR LEAVE TO FILE A DISCLAIMER AND MEMORANDUM OF ALTERATION.

2587.—Aitken, H., Falkirk, N.B., "Improvements in the manufacture of illuminating gas, and in the apparatus or means employed therefor." July 24, 1874.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2060.—Perrett, E., "Improvements in apparatus for filtering liquids." June 13, 1874.

2061.—Perrett, E., "Improvements in the arrangement of bag filters." June 13, 1874.

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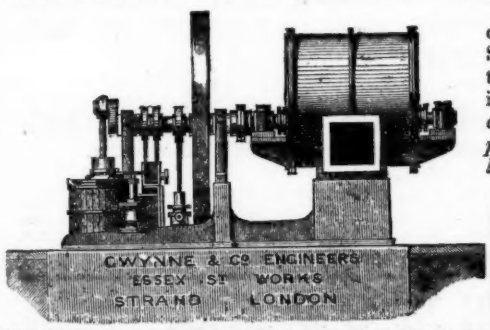

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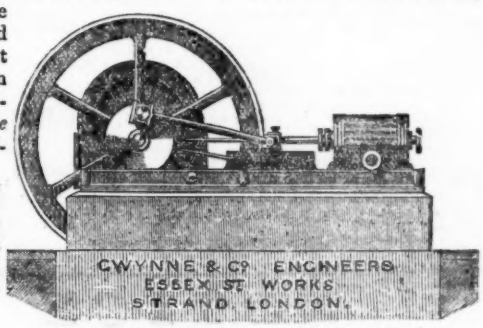

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Exhausters, with or without Engines combined, can be made to pass the gas without oscillation or variation in pressure. Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

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WANTED, a steady Man, as Main and SERVICE LAYER, and to make himself generally useful at a Gas-Work. Constant employment.
Address, stating wages, references, &c., to No. 373, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a practical mechanical Man, of good education, a Managership, or Assistant Managership of a Gas-Work. Has had charge of gas-works, and is well recommended.
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Send character, and all particulars, and wages required, to No. 379, care of Mr. King, 11, Bolt Court, Fleet Street, LONDON, E.C.

WANTED, by a Working Manager of a Gas-Work, a SITUATION. Can do main and service laying, meter-fixing, setting of retorts, clay or iron, on an improved principle, inside or outside fittings of any description. Twelve years testimonials. Abroad preferred.
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WANTED, by a Provincial Gas Company, a thoroughly qualified and experienced person to act as ASSISTANT METER INSPECTOR. Must have a thorough knowledge of Wet and Dry Gas-Meters; also Consumers Fittings.
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A Gentleman of experience in the Rating of Properties of Public Companies is willing to undertake, in the interests of Companies, the Valuation of Gas and Water Works for Rating purposes.
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THE Advertiser (24), thoroughly well up in the most approved system of gas and water accounts and general office routine, desires an appointment as Book-keeper, Rental Clerk, Assistant Secretary, or otherwise. Good penman and accountant. Reference to present employers.
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FOR SALE—Hydraulic Main, 18 in. diameter, with ascension and dip pipes complete, for five benches of retorts, suitable for a small Gas-Works.
Apply to SECRETARY, Gas and Coke Works, DEVONPORT.

FOR SALE—A Set of Four Purifiers, 8 ft. by 6 ft., with covers, grids, centre-valve, and 6-in. connexions complete.
Apply to J. GILL, Gas-Works, BRIDGNORTH.

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FOR SALE, as they now stand, and at any reasonable price, as the ground upon which they stand is wanted, four 12-ft. square Cast-Iron PURIFIERS, with centre-valve and connexions, grids, tee bars, &c., complete.
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FOR SALE One New 6-inch Centre- VALVE, by Messrs. C. and W. Walker (patent), with service connexions; not been fixed.
One STATION-METER, by Messrs. J. and J. Braddock, Oldham, for 6-inch connexions, to pass 8000 feet per hour. Has been in work five years; in first-class condition.
For particulars apply to HENRY CLARK, Secretary, Gas Company, Maldon, ESSEX.

TO BE DISPOSED OF—A Gas-Meter and GAS-COOKING APPARATUS MANUFACTORY (excellent premises) to which a Heavy Ironmongery trade might be added. Proprietor retiring.
Address R., Mr. Fenton, 1, Commercial Street, LEEDS.

TO MANUFACTURING CHEMISTS, &c.

THE Guildford Gaslight and Coke Com- pany invite TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR produced at their Works for a period of One year, from the 9th of July next.
Tenders to be sent in on or before July 5, 1877.
By order,
JOSEPH SHAW, Manager.
Guildford, June 23, 1877.

GOVERNOR FOR SALE.

THE Newmarket Gas Company have for immediate SALE a 6-in. GOVERNOR in excellent condition by H. Balfour and Co. (1875); also a 6-in. Anderson's Four-Way VALVE.
Apply to THOMAS WILKINSON, Manager, Gas Company, NEWMARKET.

THE Newmarket Gas Company invite TENDERS for the supply of a 9-in. GAS GOVERNOR, and a 9-in. Four-Way VALVE, delivered at Newmarket Railway Station.
Tenders to be sent to the undersigned on or before the 5th day of July next.
The Directors do not bind themselves to accept the lowest or any tender.
By order,
THOMAS WILKINSON, Manager.

GAS-WORKS, LOW BRIDGE, KEIGHLEY.

MESSRS. WEATHERHEAD and SKAIFE are honoured with instructions from the Gas Committee of the Keighley Local Board of Health to Catalogue and SELL BY AUCTION, on Thursday, the 5th day of July, 1877, on the above Works,
ALL the SURPLUS GAS PLANT & APPARATUS, consisting of 140 mouthpieces, 18 in. by 15 in., hydraulics, dip-pipes, exhauster; tar, liquor, and water pumps, scrubber, purifiers, station-meter, 60 tons of iron, boiler for storing tar, gasholder, 6 ft. diameter, single-lift, complete, and other apparatus, particulars of which will be given in descriptive catalogue in due course, and may be obtained from the AUCTIONEERS.
Sale at Eleven o'clock a.m.
Auctioneers Offices, Low Street, Keighley.

TO MAIN LAYERS.

THE Directors of the Hungerford Gas Company are prepared to receive TENDERS for the laying of about 400 yards each size of 5 in., 3 in., and 2½ in. MAINS, and other works in connexion.
Further particulars may be obtained on application to the Secretary.
Tenders to be sent in on or before the 30th day of June, 1877, addressed to the Chairman of the Hungerford Gas Company.
J. H. WOOLDRIDGE, Secretary.

GASHOLDER FOR SALE.

ONE Telescopic Gasholder, 70 feet by 20 feet, complete, with cast-iron tank, columns, girders, and inlet and outlet pipes, valves, &c., of modern construction. In first-class condition, and made by Messrs. Piggott and Co., of Birmingham.
To be seen at work at the Gas-Works, Birkenhead.
Cause of removal to make room for extensions.
To be sold a bargain, taken down, and re-erected ready for work.
For particulars, apply to Messrs. ASHMORE AND WHILE, STOCKTON-ON-TEES, or to view to Mr. CALLOW, Gas Engineer, BIRKENHEAD.

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FOR THE YEAR 1877,
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THIS WORK IS UNDER THE PATRONAGE OF ALL THE LEADING GAS & WATER ENGINEERS AND SECRETARIES OF THE METROPOLITAN & PROVINCIAL COMPANIES.

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GEORGE ORME & CO.,
ATLAS METER-WORKS, OLDHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
STATION-METERS, GOVERNORS,
PRESSURE AND EXHAUST REGISTERS,
LAMP-METERS IN CAST-IRON BOXES,
And every Description of Gas Apparatus.

B. GIBBONS, JUN.,
DIBDALE FIRE-CLAY, BRICK, AND GAS-RETORT WORKS,
STOURBRIDGE (Established 1834),
MANUFACTURER OF EVERY DESCRIPTION OF
Burs, Lumps, Stays, Shields & other Bricks, & Gas-Retorts.
A LARGE QUANTITY OF RETORTS ALWAYS IN STOCK.

Circular .	14 in.,	15 in.,	16 in.,	18 in.
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Special attention given to the execution of Export Orders.

NOTICE OF REMOVAL.

D. BRUCE PEEBLES & CO.

Beg to announce that they have REMOVED to their New Premises,

TAY WORKS, BONNINGTON, EDINBURGH,

To which all communications should now be addressed.

May 30, 1877.

Just Published, Price 2s. 6d.,

COMMON SENSE FOR GAS USERS,

Being a Catechism of Gas Lighting for Householders, Gas-Fitters, Architects, Engineers, Millowners, &c.

By ROBERT WILSON, C.E.

CROSBY, LOCKWOOD & CO., 7, STATIONERS HALL COURT, E.C.

THE THAMES BANK IRON COMPANY,

(Successors to LYNCH WHITE,)

SUPPLY FROM STOCK

CAST-IRON RETORTS, SOCKET-PIPES for GAS or WATER PURPOSES, FLANGE-PIPES for STEAM, RAIN-WATER PIPES and GUTTERS, HOT-WATER PIPES and BOILERS, and all requisite Connexions for same; also LAMP-COLUMNS, LAMPS, WROUGHT FRAMES, WROUGHT-IRON TUBING, &c., &c.

All kinds of Gas-Works Apparatus and General Castings made to Pattern or Drawing.

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Manufacturers of FIRE-BRICKS, LUMPS, TILES,

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MANUFACTURERS OF EVERY DESCRIPTION OF

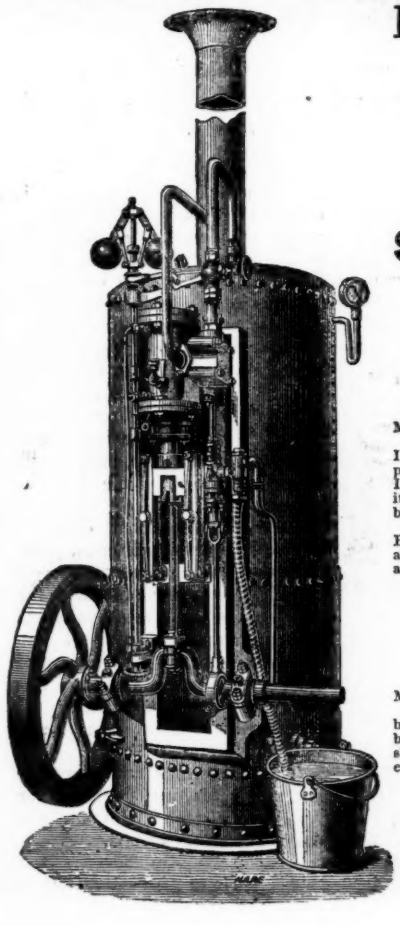
GAS APPARATUS.

CONTRACTORS FOR THE

ERECTION OF GAS-WORKS, GAS-FITTINGS, &c.,

FOR TOWNS, COUNTRY MANSIONS, &c.

Estimates given free of Charge.



HAYWARD TYLER & Co.'s

PATENT

COMBINED BOILER

AND

"UNIVERSAL"

STEAM PUMP

Forms an exceedingly compact arrangement, requiring no foundation.

TESTIMONIALS.

Gas Company's Office, Luton, Beds, Aug. 30, 1873.

Messrs. Hayward Tyler & Co.

Gentlemen,—The 9-inch by 6-inch Steam Pump which I had from you worked in a most satisfactory manner, and perfectly answered the purpose for which it was required. I used it for emptying a gasholder-tank, and for refilling it with water. The quantity of water delivered was far beyond my expectations.

Steam was led into it from our Stationary Engine Boilers, through 1¼-inch wrought-iron pipe, a distance of about 90 feet; the whole occupied a fitter less than a day, and work commenced without loss of time.

Yours truly,

(Signed) W. Phillips,

Engineer of Luton Gas Co.

Ratcliff Gaslight & Coke Co., New Crane, Wapping, London, July 25, 1872.

Messrs. Hayward Tyler & Co.

Dear Sirs,—Have you one of your "Universal" 4-inch by 3-inch Steam Pumps in stock, and how soon could it be delivered? It is for pumping ammonia water, and should have cast-iron clacks. The one I have works capitally.—Yours, in haste,

(Signed) Hy. E. Jones.

N.B.—Two more have since been supplied.

84, WHITECROSS STREET,

LONDON, E.C.

THE Newport (Mon.) Gas Company

have FOR SALE the following PLANT at their Works, Newport, Mon.:—

Two Cylindrical Boilers, 13 ft. by 4 ft., with fittings complete, and steam-pipes to engines.

Two Horizontal Engines, each cylinder 9½ in. diameter, and stroke of each 1 ft. 6 in.

Two Beale's Exhausters, made to pass 20,000 cubic feet per hour each, with regulators and bye-pass.

The above are in good order, have been working during the past winter, and are now offered for sale because larger ones have been fixed.

Particulars and prices given for the whole or a portion of the Plant on application to the undersigned.

They can be seen at the Works, Mill Street, Newport, Mon.

Thomas Canning, Engineer.

May 18, 1877.

GLASGOW CORPORATION GAS.

RESIDUAL PRODUCTS FOR SALE.

THE Gas Committee of the Glasgow

Corporation Gas Commissioners are prepared to receive TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR produced at the Tradeston Gas-Works, from and after Nov. 11, 1877. The contract to be for such number of years as may be agreed upon.

Forms for tender, on which offers must be made, may be had, and further particulars obtained, on application to the Manager, at the Gas Office, 42, Virginia Street, Glasgow, and offers, endorsed "Tender for Residual Products," will be received by the subscriber up till the 10th of July next.

The Committee do not bind themselves to accept the highest or any tender.

J. D. Marwick, Town-Clerk, Clerk to the Commissioners.

City Chambers, Glasgow, June 12, 1877.

TO CONTRACTORS FOR GAS-WORKS.

THE Smethwick Local Board of Health

are prepared to receive TENDERS for the construction of Two Brick GASHOLDER-TANKS, 87 ft. diameter, according to the plans and specifications of F. J. Bramwell, Esq., M.Inst.C.E., which, with the form of tender, may be seen at the Offices of the Local Board Public Buildings, Smethwick, on and after the 20th of June, 1877, and between the hours of Ten o'clock a.m. and Four o'clock p.m.

Tenders must be sent to the undersigned not later than the 23rd day of July, 1877.

Ralph Docker, Clerk to the Local Board.

Public Buildings, Smethwick, near Birmingham, June 11, 1877.

TO GASHOLDER MANUFACTURERS.

THE Smethwick Local Board of Health

are prepared to receive TENDERS for the construction of Two TELESCOPIC GASHOLDERS, 85 ft. diameter, with their standards, &c., &c., according to the plans and specifications of F. J. Bramwell, Esq., M.Inst.C.E., which, with the form of tender, may be seen at the Offices of the Local Board Public Buildings, Smethwick, on and after the 20th of June, 1877, between the hours of Ten o'clock a.m. and Four o'clock p.m.

Tenders must be sent to the undersigned not later than the 23rd day of July, 1877.

Ralph Docker, Clerk to the Local Board.

Public Buildings, Smethwick, near Birmingham, June 11, 1877.

TO COLLIERY PROPRIETORS, COAL MERCHANTS AND OTHERS.

THE Directors of the Stratford-upon-

Avon Gas Company invite TENDERS for the supply of 2000 Tons of good screened GAS COAL, to be delivered free upon their siding, Great Western Railway Company, in monthly quantities as may be required, between the 1st of July, 1877, and the 30th of June, 1878.

The Coal to be of good quality, and free from bats, bind, pyrites, and other refuse.

Parties tendering to state the kind of Coal, and from what district and pits obtained.

Terms of payment, net cash monthly.

Tenders to be sent in not later than Monday, July 2, 1877.

The Directors do not bind themselves to accept the lowest or any tender.

J. S. Cranmer, Secretary.

June, 1877.

BOROUGH OF BARROW-IN-FURNESS.

CONTRACT FOR SUPPLY OF GAS COAL AND CANNEL.

THE Corporation are prepared to receive

TENDERS for the supply of about 6000 Tons of GAS COAL and 2500 Tons of CANNEL, to be delivered at the Gas-Works in such quantities as may be required during the twelve months ending June 30, 1878.

Particulars and conditions of contract may be obtained on application to the Manager of the Gas-Works.

Sealed tenders, addressed "The Chairman of the Gas and Water Committee," and endorsed, to be sent in to me not later than Saturday, the 30th inst.

The lowest or any tender not necessarily accepted.

C. F. Preston, Town-Clerk.

Municipal Offices, Barrow-in-Furness, June 20, 1877.

LEEK IMPROVEMENT ACT, 1855.

CONTRACT FOR GAS COAL.

THE Leek Improvement Commissioners

invite TENDERS for a supply of Best GAS COAL to their Works for One, Two, or Three years, from the 1st of July, 1877, delivered free at the Leek Railway Station or Canal Wharf at such times and in such quantities as may be required by their Manager for the time being, or by the undersigned.

Sealed tenders addressed to the Chairman of the Gas Committee, Commissioners Offices, Leek, must be received before Four o'clock p.m. on Monday, the 9th of July next.

The Commissioners do not bind themselves to accept the lowest or any tender.

Further particulars may be obtained from

C. Henshaw, Clerk to the Commissioners.

Russell Street, Leek, June 15, 1877.

TO GAS COMPANIES.

WE beg to call attention to our special STEATITE BURNERS for Street Lamps. Sample gross 8s. Quotations for quantities.

Messrs. TINDALL AND TELLING, Gas Apparatus Works, 74, Wynford Road, Penton Street, LONDON, N.

PAMPHLET ON GAS.

COOKING AND HEATING.

HINTS ON GAS-BURNERS, &c.

For GAS COMPANIES to distribute to their Gas Consumers.

Specimen Copy by post Threepence, from the Author,

MAGNUS OHREN, Gas-Works, Sydenham, S.E.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

HENRY LYON,

ENGINEER,

AND

CONSULTING GAS ENGINEER,

BARTON HOUSE, opposite BARTON ARCADE, DEANSGATE, MANCHESTER.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

JOHN ROMANS, C.E., F.G.S.E.,

CONSULTING GAS ENGINEER

AND

CANNEL COAL FACTOR,

30, St. Andrew Square, EDINBURGH.

Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

GAS-WORKS TAKEN ON LEASE.

Mr. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

ANALYSIS AND PRICES FORWARDED ON APPLICATION.

CATHELS'S Patent Gas-Washer is an excellent cleanser of gas from tar, ammonia, sulphur, and carbonic acid, reducing the cost of subsequent purification 30 to 50 per cent. Needs no motive power or attention beyond drawing off and recharging as required. Has no moving parts or complications to get out of order. Is of moderate cost, and is practically indestructible.

Application to be made to the MANUFACTURERS, the Horseley Company, Tipton, STAFFORDSHIRE.

PATRONIZED BY THE ROYAL ARSENAL, WOOLWICH.

FERGUSON, Builder and Contractor. Kite method of Repairing Church Spires and High Chimneys. Chimneys straightened, pointed, and hooped. Old Chimneys pulled down by a process requiring no scaffolding or stoppage of work, by competent workmen, under personal supervision. For Lightning Conductors—cheapness and method of fixing—apply to C. R. FERGUSON, 12, Canal Road, MILE END.

ADDISON POTTER,

WILLINGTON QUAY,

NEAR NEWCASTLE-UPON-TYNE,

Manufacturer of

CLAY RETORTS, FIRE-BRICKS, AND EVERY DESCRIPTION OF FIRE-CLAY GOODS

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS,

&c., &c.,

SCOTSWOOD FIRE-BRICK WORKS,

SCOTSWOOD-ON-TYNE.

BOUCK & CO., LIMITED,

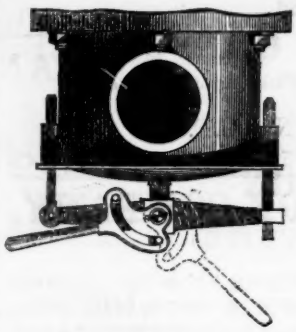
TAR DISTILLERS & MANUFACTURING CHEMISTS,

MILES PLATTING, MANCHESTER.

BUYERS OF COAL TAR,

And Crude Products therefrom,

AMMONIACAL LIQUOR, &c.



STORER & PUGH'S

PATENT

RETORT-LID FASTENINGS

Have now stood the test of experience, and have been found one of the greatest improvements in retort-house appliances yet invented. All who desire security and economy should give them a trial.

Prices and further particulars will be given on application to

J. STORER,

GAS-WORKS, STAFFORD.

J. T. B. PORTER & CO.,

GAS ENGINEERS & MANUFACTURERS,

IRONFOUNDERS AND CONTRACTORS,

GOWTS BRIDGE WORKS,

LINCOLN.

LONDON OFFICES: 1, WESTMINSTER CHAMBERS, S.W.

ESTIMATES FOR GAS-WORKS OF ANY SIZE.

REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—All Communications to be addressed to the **FIRM ONLY.**

J. & J. BRADDOCK,

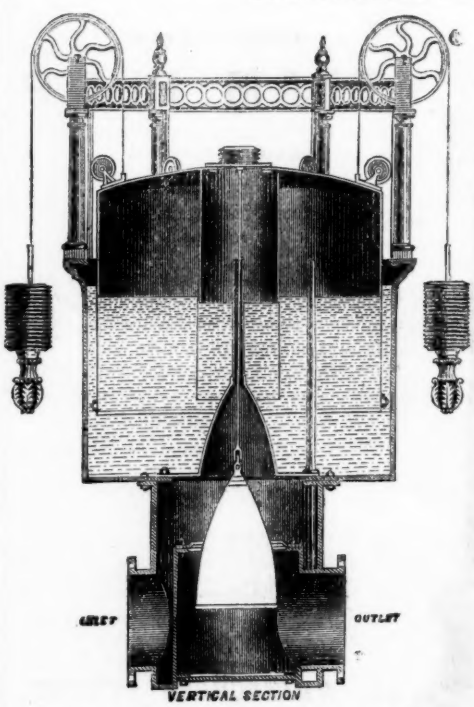
GLOBE METER-WORKS,

OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

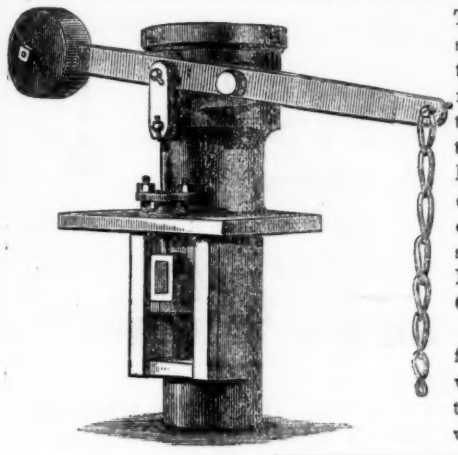
The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

MOORE'S PATENT DIP-PIPE.



THE advantages of this Dip will be seen from the engraving. It is thoroughly effectual in its working, removing the whole of the pressure of the hydraulic main from the retort, thus causing a great saving in gas. It is very easy of manipulation, requiring little care and attention; it cannot get out of order, and, when shut, works as an ordinary Dip-Pipe. No accumulation of carbon in retort. Can be fixed to existing H-pipes.

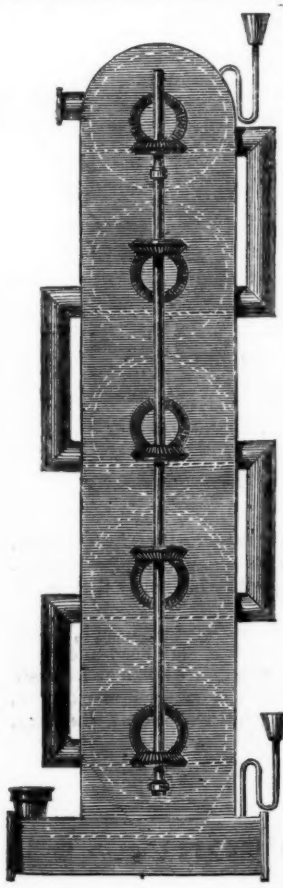
In ordering the Dip, the distance from top side of hydraulic main to water-level should be stated; also the Dip at which it is required to work when the valve is shut.

PRICES—3-in., 35s.; 4-in., 42s.; 5-in., 48s.

SOLE AGENT: J. GILL, GAS-WORKS, BRIDGENORTH,
To whom all communications should be addressed.
MAKERS: THE COALBROOKDALE COMPANY, SHROPSHIRE.

GEORGE ANDERSON,
GAS AND CONSULTING ENGINEER,
35A, GREAT GEORGE STREET,
WESTMINSTER, S.W.

ANDERSON'S
PATENT
COMBINED WASHER AND SCRUBBER.



TESTIMONY OF ITS ACTION.

The Gas-Works, St. Albans,
April 27, 1877.

DEAR SIR,

Your Brush Scrubber has been in action here for four months.

It removes the whole of the ammonia from the gas, so that it will not discolour moistened turmeric paper.

The brushes cause no appreciable increase of pressure, and there is no repumping of liquor. Clear water run in at top, issues from the bottom fit to proceed to the sulphate-house.

It performs its work more efficiently than the tower scrubber I have, while only about half the height, and not one-fourth its weight or capacity.

My purifiers also last much longer before they are foul than they did previously.

I am, yours truly,
A. F. PHILLIPS.

G. Anderson, Esq.,
35*a*, Great George Street, S.W.

PATENTEE and MANUFACTURER of the following Inventions:—

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

PRICES AND ALL PARTICULARS TO BE HAD OF THE PATENTEE,
35a, GREAT GEORGE STREET, WESTMINSTER, S.W.

YEO'S PATENT ENGINE PACKING AND IMPROVED YARN FOR GAS AND WATER PIPE JOINTS.

EPHRAIM YEO, Inventor, Patentee, and Sole Manufacturer of the Patent Excelsior Self-Lubricating Rope Engine Packing, price 1s. 8d. per lb., any size. Carriage paid on ¼ cwt. and upwards to any Railway Station in the Kingdom. Best Tarred Spun-Yarn for Gas-Pipe Joints, 28s. per cwt. Best White Ditto, any size, 36s. per cwt. Best Ditto, boiled in Oil and Tallow, 36s. per cwt. Coke Sacks, any length or width, Tarred or Untarred. Carriage paid to any Railway Station in the Kingdom. Address—

E. YEO, NEWTON ABBOT, DEVONSHIRE.

CLOTH GAS-BAGS FOR MAINS,

As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather, India-Rubber, and Gutta-Percha Machine-Bands, Sheet and Washers, and Steam Joints.

T. BUGDEN, Manufacturer,
79, GOSWELL ROAD, LONDON, E.C.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,524 cubic feet per ton of 14½-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonized were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

THE TYNE COAL COMPANY, LIMITED, OWNERS.
W. RICHARDSON, Fitter,
29, QUAYSIDE, NEWCASTLE-ON-TYNE.

TORBAY AND DART PAINT COMPANY, LIMITED.

WORKS:
DARTMOUTH & BRIXHAM (TORBAY) DEVON.
OFFICES:
23, GREAT GEORGE STREET, WESTMINSTER, LONDON, S.W.

SOLE PROPRIETORS AND MANUFACTURERS OF
WOLSTON'S CELEBRATED
TORBAY IRON PAINTS.

TRADE MARK

These Paints have been for many years extensively used in Her Majesty's Royal Dockyards, Woolwich Arsenal, the Shorncliffe and Curragh Camps, War Departments, and Colonies, and are largely supplied to Railway, Harbour, and GAS COMPANIES, Shipowners, Engineering Establishments, Railway Carriage and Wagon Works, and the Paint Trade generally. They are the BEST PROTECTORS of WOOD, CEMENT, and IRONWORK, even arresting corrosion after it has set in; and their base being oxide of iron, they are free from those properties which make lead paints so destructive to iron. They do not scale or blister, are not affected by great heat, and are the only Paints which will resist the effects of sulphuretted hydrogen. Their DURABILITY and covering properties have borne the test of A QUARTER OF A CENTURY'S PRACTICAL TRIAL.

The undermentioned colours—ground in best linseed oil, and requiring only to be thinned down for use in the ordinary way—are kept in stock:—

Torbay Brown.	Torbay Red.
Dart Green.	Slate.
Dart Yellow.	Buff.
Brixham Black.	Torbay Chocolate.
Light Blue.	Cream Colour.
Dart Brown.	Dart Umber.
Imperial Stone.	Light Stone.
Bronze Green.	Salmon Colour.
Navy Green.	Lead Colour.
Carriage Red.	Dark Stone.
Light Lead.	Crystal Palace Blue.
Light Green.	Iron Grey.

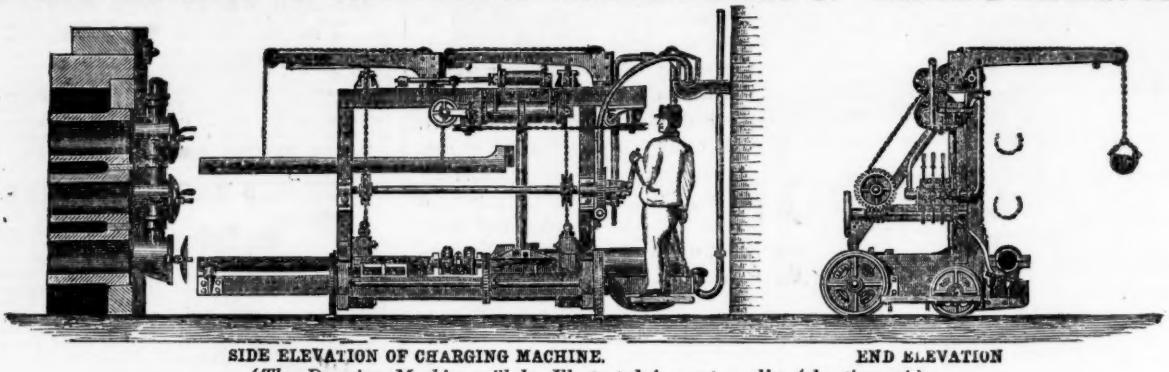
All other Colours made to order.

READY-MIXED PAINTS.

A great variety of Colours ready mixed for the brush are also always kept in Stock, in 3 lb., 7 lb., 14 lb., and 28 lb. cans.

Prices and Testimonials on application.

FOULIS'S PATENT STOKING MACHINE.

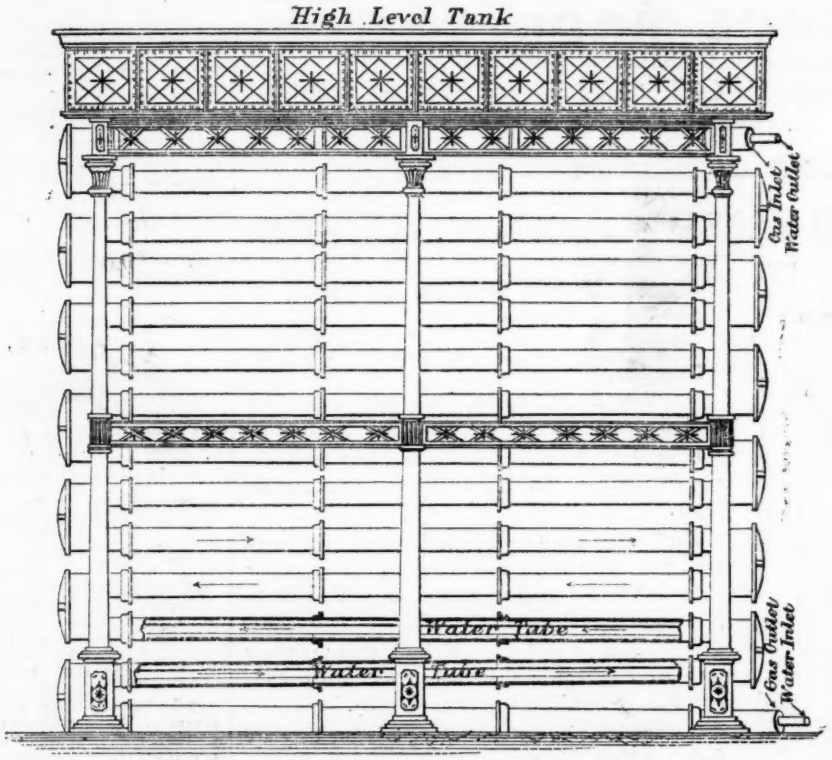


SIDE ELEVATION OF CHARGING MACHINE. END ELEVATION

(*The Drawing Machine will be Illustrated in next week's Advertisement.*)

Makers: TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester; ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz; Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

MORRIS & CUTLER'S PATENT CONDENSER.



The Condenser may consist of pipes arranged in tiers as shown, or in any other form most convenient to the site available, each tier being connected with special connexions, and containing within same either one or more coils of smaller pipe through which water is passed, being supplied from any convenient source of supply, the water passing in an opposite direction to the gas, so that the coldest water is at the gas outlet.

The power of the Condenser can be regulated precisely in proportion to the quantity of water allowed to pass through, which is not in any way contaminated, but simply heated by the hot gas, and advantage can be taken of its being at a high level to carry it to a high-level cistern, from whence it can be used for supply to boiler or any other purpose. (The Condenser itself may form the support for a high-level cistern as illustrated.) By an arrangement of valves the water may be shut off, and an air orifice opened, when air will pass through instead of water, or both air and water can be shut off. The power of the Condenser is, therefore, entirely under control.

The Condenser may be seen in operation at the Brentford Gas-Works.

For further Particulars, apply to

Mr. F. MORRIS, GAS-WORKS, BRENTFORD,

OR TO

S. CUTLER & SONS,

ENGINEERS, IRONFOUNDERS, AND CONTRACTORS FOR GAS AND WATER-WORKS,

MILLWALL, E.

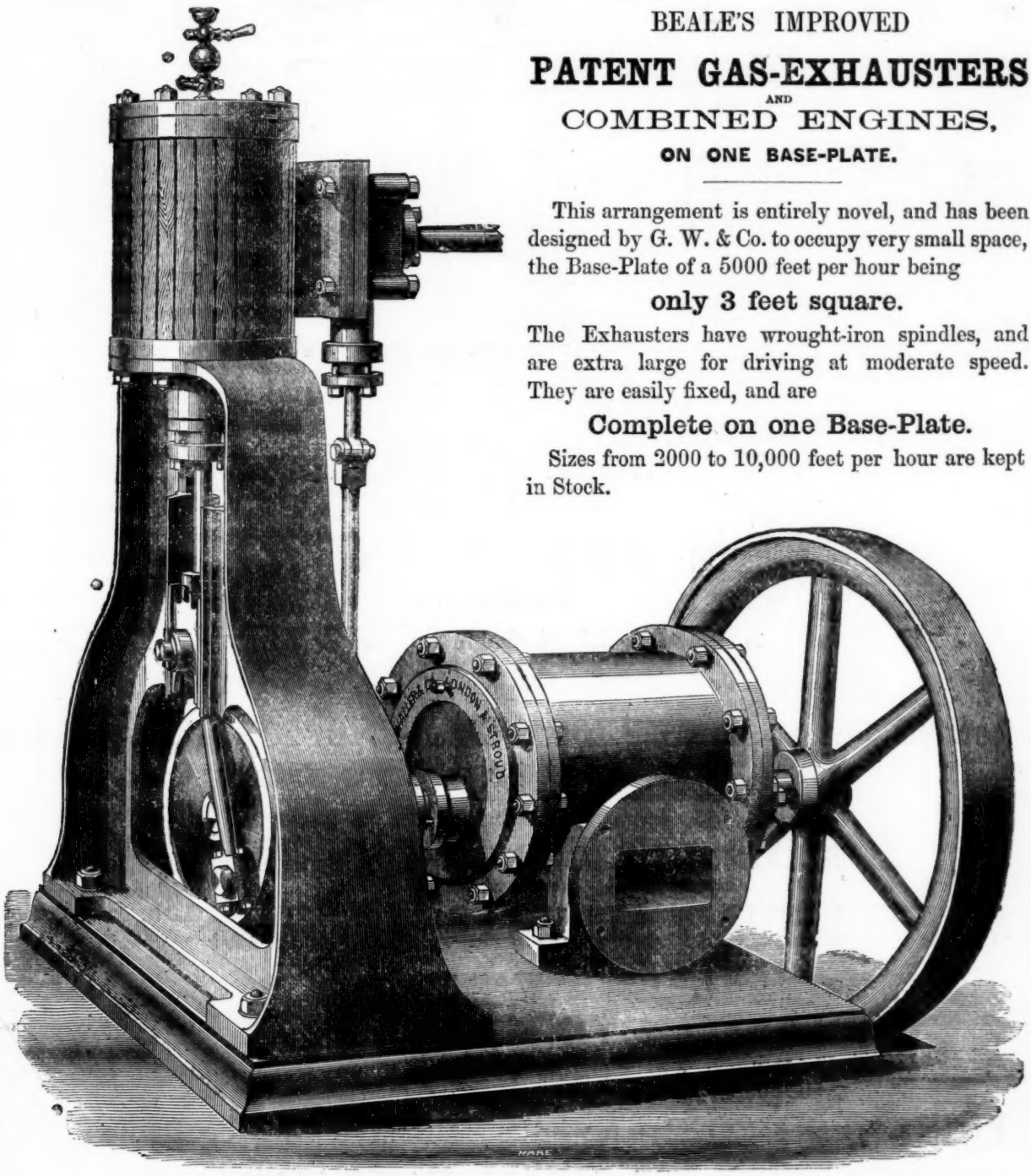
THE WIGAN COAL & IRON COMPANY,
LIMITED.

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

GEORGE WALLER & CO.,
GAS ENGINEERS AND CONTRACTORS.



BEALE'S IMPROVED

PATENT GAS-EXHAUSTERS
AND
COMBINED ENGINES,
ON ONE BASE-PLATE.

This arrangement is entirely novel, and has been designed by G. W. & Co. to occupy very small space, the Base-Plate of a 5000 feet per hour being

only 3 feet square.

The Exhausters have wrought-iron spindles, and are extra large for driving at moderate speed. They are easily fixed, and are

Complete on one Base-Plate.

Sizes from 2000 to 10,000 feet per hour are kept in Stock.

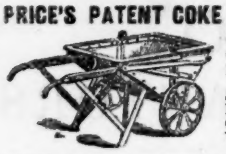
Index and Disc Gas-Valves, Self-Acting Bye-Pass Valves, Hydraulic Regulators, Hydraulic Main Valves, Pumps, Coke Barrows, Retort Tools, &c., always in Stock.

PHŒNIX ENGINEERING WORKS, HOLLAND STREET, SOUTHWARK, LONDON, S.E.

ALFRED LASS,
SPECIAL ACCOUNTANT FOR GAS COMPANIES,
30, GRACECHURCH STREET, LONDON.

Accounts analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.
The Forms of Account, which have been specially designed by A. L. to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.
The above forms are registered.
Water Companies Accounts also prepared and adjusted.
CONSULTATIONS.

PRICE'S PATENT COKE & COAL BARROW



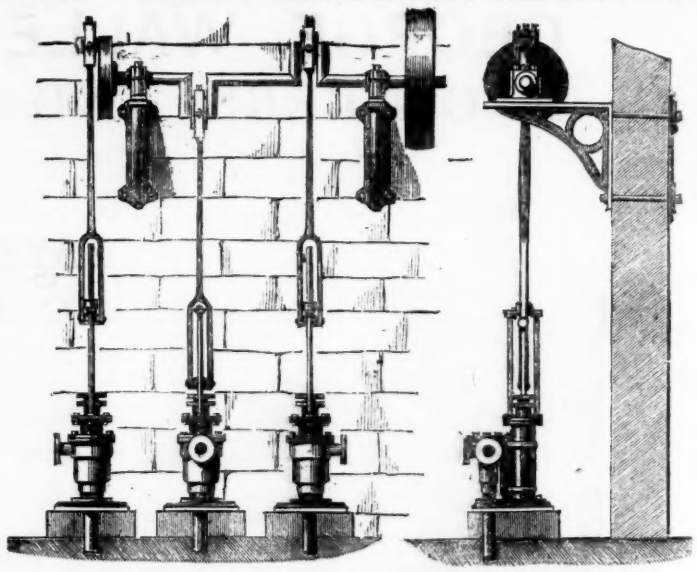
effecting a great saving of time, labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

THOMAS LAMBERT & SONS
MANUFACTURE EVERY DESCRIPTION OF
GAS AND WATER FITTINGS;
ALSO,
WROUGHT-IRON TUBES & FITTINGS.
SHORT STREET, LAMBETH, LONDON.

BELGIAN CLAY RETORTS.
J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.
Communications addressed to J. SUGG & CO., GHENT, will receive immediate attention.

JAMES NEWTON & SONS,
(Established 1820,)
FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
FALCON DOCK, 78 AND 79, BANKSIDE,
SOUTHWARK, LONDON, S.E.,
DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY,
and every Article suitable for
GAS AND WATER WORKS.

S. OWENS & CO.,
WHITEFRIARS STREET, FLEET STREET, LONDON, E.C.,
Hydraulic Engineers,
AND MANUFACTURERS OF
PUMPING MACHINERY of every Description.
SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF
BLAKE'S PATENT DIRECT-ACTING STEAM-PUMPS.



IMPROVED DOUBLE-ACTION PUMPS.
For Water. For Tar. For Ammoniacal Liquor.

This illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.
These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.
GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.
Illustrated Catalogues sent post free on application.

JOHN ABBOT AND CO.,
LIMITED,
IRON AND BRASS FOUNDERS,
PARK WORKS, GATESHEAD-ON-TYNE.
London Office: 2, SUFFOLK LANE, CANNON STREET.
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MANUFACTURERS OF ALL DESCRIPTIONS OF
HYDRAULIC MACHINERY,
INCLUDING
ACCUMULATORS, FORCE-PUMPS, CRANES, & LIFTS,
FOR
GAS-WORKS, WAREHOUSES, &c.
IMPROVED HYDRAULIC MACHINERY,
Specially Arranged for Lifting and Lowering Purifier-Covers, &c.
MAKERS OF
PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS;
PIPES FOR GAS AND WATER WORKS;
ROOFS, COLUMNS, AND GIRDERS.

DESIGNS AND ESTIMATES SUPPLIED ON APPLICATION.

June 25, 1877.

TO THE PURCHASERS OF GAS-METERS.

GENTLEMEN,—Though you are fully alive to the great importance of the subject of Gas-Meters, and should claim the right of *private* judgment as to the reliance which may be placed on any description of Meter, yet we feel constrained to respectfully draw your attention to the following statement of facts:—

FIRST.—A MEASURE OF UNVARYING CAPACITY is the only "reliance principle" upon which a Meter can be constructed.

SECOND.—The drum or wheel of every Meter BUT the "WARNER and COWAN" is a variable measure.

THIRD.—For upwards of fifty years this defect has been attempted to be remedied, *not* by dealing with the measure itself, as Messrs. Warner and Cowan have so successfully done, but by supplementing the mechanism for effectuating true measurement by dealing with the water-level.

FOURTH.—All such arrangements have again and again been revived and abandoned from failure of the arrangements for maintaining the water-level, they being necessarily delicate and complex.

FIFTH.—The "Warner and Cowan" Meter is as simple in action as the common Meter, and will register correctly under every variation of water-line.

SIXTH.—We will guarantee practical ACCURACY under EVERY CHANGE OF WATER-LEVEL.

SEVENTH.—The "WARNER and COWAN" is the ONLY NEW PRINCIPLE introduced into the Meter since its invention.

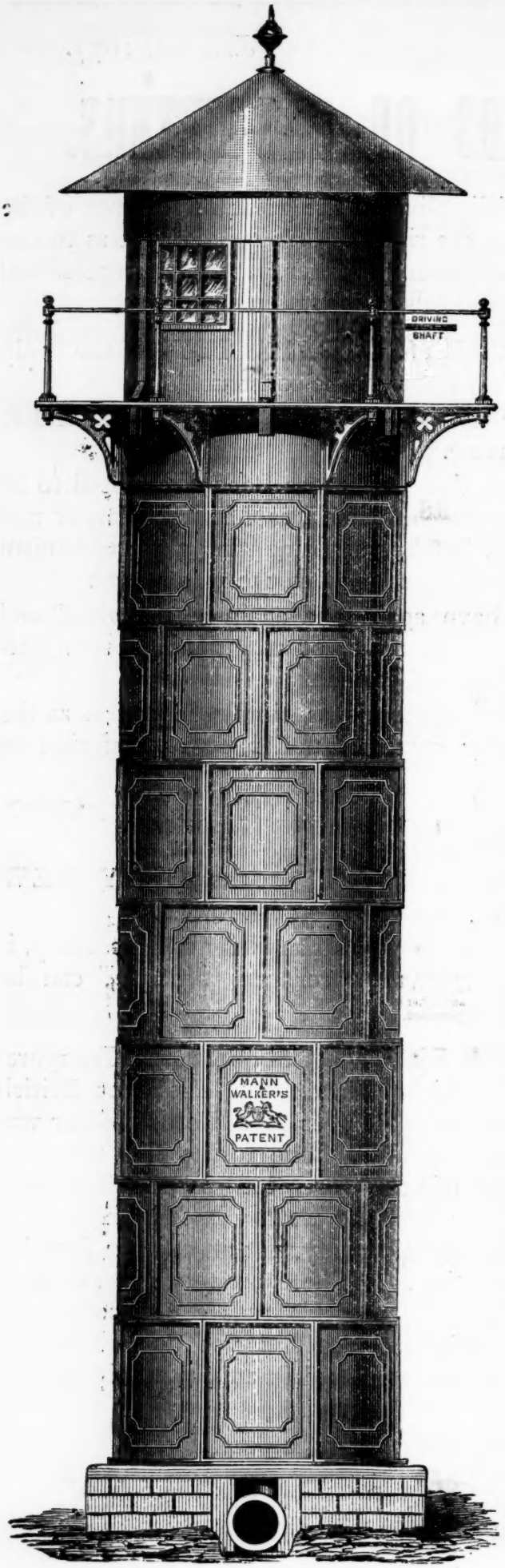
EIGHTH.—The "Warner and Cowan," from its simplicity and accuracy, is the only one to which the name of the "reliance principle" can be JUSTLY applied.

It is with the greatest pleasure that we again quote the Inaugural Address of James Paterson, Esq., F.G.S., of Warrington, President British Association of Gas Managers at Leeds, in whose year of office the Meter was brought before the public—an address second to none for its high tone as a professional communication, and one of the foremost for the fairness, impartiality, and scientific manner with which he dealt with this important subject of Meters—not an expression of opinion only, but an opinion founded upon the results of testing and observation. "There are, however, degrees of what may properly be termed excellence; and this leads me to notice one of the most beautiful applications which science has yet devised in the construction of the Meter, and which has rendered it an absolutely reliable and unvarying instrument."

We remain, Gentlemen, yours respectfully,

W. & B. COWAN.

London, Manchester, and Edinburgh.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im-portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

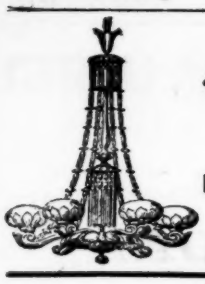
They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, re-quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.



F. & C. OSLER,

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MANUFACTORY AND SHOW-ROOMS:

BROAD STREET, BIRMINGHAM.

ESTABLISHED 1807.

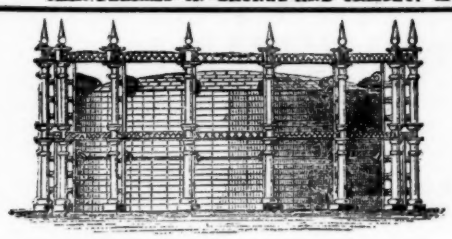
MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

HOPE IRON WORKS,



STOCKTON ON TEES.

ASHMORE & WHILE,

GAS ENGINEERS & CONTRACTORS,

MANUFACTURERS OF GASHOLDERS,

GAS APPARATUS OF EVERY DESCRIPTION,

Including Improved

Retort-Lids, Boilers, Cast and Wrought Iron Tanks, Iron Roofing, Bridges, Girders,

And GENERAL IRONWORK.

N.B.—Estimates for all Gas Plant and Remodelling supplied on application.

LESMAHAGOW CANNEL COAL.

FERRAND DAVIES,

148, GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.,

SOLE AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL.

Quotation and Analysis forwarded on application.

G. J. EVESON,

GAS COAL AND CANNEL FACTOR,

Has on offer, in quantities to suit purchasers, Best Wigan Arley Mine, Orrell Screened and Unscreened Gas Coal and Nuts; Best Yorkshire, Real Old Silkstone, Derbyshire, and North Staffordshire Screened and Unscreened Gas Coal and Nuts; also Best Lancashire, Yorkshire, Derbyshire, and other Cannel, as supplied to some of the principal Gas Companies in England, to whom references are permitted.

Analysis and Prices forwarded on application to

HEAD OFFICES, STOURBRIDGE.

N.B.—Gas Managers will oblige by advising when they will be prepared to receive Tenders.

STOURBRIDGE FIRE-BRICKS, RETORTS, CLAY, &c.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

173, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

WILSON CARTER & PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or export Best Wigan Arley Gas Coal and Nuts; best qualities of the Derbyshire, Yorkshire, and North Staffordshire Gas Coals and Nuts; also the best descriptions of Lancashire, Welsh, Scotch, and other Cannel.

Messrs. WILSON CARTER & PEARSON, being contractors to several of the principal Gas Companies in the Midland Counties, have pleasure in being enabled to give them as references.

Chief Offices: Temple Buildings, 50, New Street, Birmingham.

London Offices: 6, Great Winchester St. Buildings, E.C.

GRIRDROD'S PATENT PORTABLE PIPE SCREWING MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

W. H. BAILEY & CO.,

Brassfounders, Gauge Injector and Tool Makers,

ALBION WORKS, SALFORD, LANCASHIRE.

ALBERT GAS COAL.

THE DERBYSHIRE

SILKSTONE COAL COMPANY, LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered in trucks at any Railway Station in England, or shipped on board at Hull, Grimsby Docks, or Barrow-in-Furness.

Purified gas per ton of coal in cubic feet (average)	**10,262**
Illuminating power in candles	**15·86**
Weight of coke in lbs. per ton of coal	**1,502**

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

THE

WIGAN & WHISTON COAL COMPANY,

LIMITED,

(COLLIERIES—PRESCOT, NEAR LIVERPOOL)

Are now prepared to supply their

RUSHY PARK GAS COAL,

Either to Gas-Works in England or Wales, or for Shipment, at Runcorn, Garston, Birkenhead, or Liverpool.

This Coal is of superior quality, and yields in practical working over 10,000 cubic feet of Purified Gas per ton, with an Illuminating Power of 17½ candles.

One Ton of Coal yields 1441 lbs. of good Coke.

For prices, &c., apply either direct to the Colliery or to the Company's Office,

195, FALKNER STREET, LIVERPOOL.

SILKSTONE GAS COAL

AND

LANCASHIRE AND MIDLAND CANNEL.

EMOR G. WRIGLEY, Merchant,

Having made arrangements with four large Collieries for the exclusive sale of their GAS COAL and CANNEL, can offer to Gas Companies large quantities, for delivery over one or two years, at exceedingly low prices. His REAL OLD SILKSTONE GAS COAL will give, in regular work, 10,200 feet 16·6 candle gas and 13 cwt. superior coke; and a WIGAN CANNEL 11,375 feet 21·75 candle gas and 12 cwt. superior coke.

PRICES AND ANALYSIS WILL BE FORWARDED TO ANY PART ON APPLICATION TO THE CHIEF OFFICE,

120a, STAMFORD STREET, ASHTON-UNDER-LYNE.

1862.

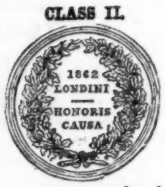
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.



This Paint having been in general use over fifteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

SPECIAL DRIERS FOR ANTIMONY PAINT SUPPLIED.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

Messrs. NEWTON, CHAMBERS, AND CO.,

Gentlemen,

After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

The average of Nine samples gives a yield of 12,500 cubic feet of 15½ Candle Gas, being equivalent to 664 lbs. of sperm per ton, and 1420 lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

Yours truly,

JAMES PATERSON.

Full particulars will be sent on application to us—address as above.

CROLL'S
DRY GAS-METERS,

PRIZE MEDALS.
LONDON, 1851;
NEW YORK, 1853
PARIS, 1855.

(INVENTED & PATENTED IN 1844,)

COMBINING ALL THE LATEST IMPROVEMENTS,

MANUFACTURED ONLY BY

PRIZE MEDALS.
LONDON, 1862;
DUBLIN, 1865;
PARIS, 1867.

THE GAS-METER COMPANY, LIMITED,

238, KINGSLAND ROAD, LONDON, N.E.

ALEXANDER WRIGHT & CO.,

55, 55a, & 56, MILLBANK STREET, WESTMINSTER,
LONDON, S.W.,

WET AND DRY GAS-METER AND GAS APPARATUS MANUFACTURERS.

Now Ready, price 1s., post free.

AMMONIA LIQUOR TESTS.

BY

F. W. HARTLEY, A. Inst. C.E., &c.

The strength and therefore the commercial value of Gas Liquor has heretofore been determined by tests of very uncertain character—unsatisfactory alike to the vendors and buyers of this product.

In the above-named little Work will be found clear explanations of the usual methods by which the strength of Liquor is ascertained, an exposition of the imperfections of those methods, together with instructions for testing on an improved system, by which the total quantity of Ammonia in Gas Liquor may be determined with facility.

R. LAIDLAW AND SON,

EDINBURGH AND GLASGOW.

Manufacturers of

CONSUMERS IMPROVED WET GAS-METERS,

THE UNVARYING WATER-LINE GAS-METERS,

IMPROVED DRY GAS-METERS, in Cast-Iron or Tin-Plate Cases;

STATION-METERS, ALL SIZES, up to 15 feet Square, with PLANED JOINTS;

Experimental Meters, Photometers, Pressure-Gauges,
Governors, Test Holders, &c., &c.

LONDON OFFICE: 106, CANNON STREET, E.C.

Established

1795.

JOSEPH CLIFF & SONS,

THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

London Wharf: No. 4, inside Great Northern Goods Station,
King's Cross, N.;

LIVERPOOL: Back Leeds Street.

SPECIAL NOTICE.—Our Patent Machine-made Retorts have now been in *actual work* nearly 800 days, and are yet in good order. References on application.

London: Printed by WILLIAM BOUGHTON KING (at the office of Clayton and Co. 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 26, 1877.